Devoted to Civil Engineering and Contracting. McGraw-Hill Company, Inc.

February 15, 1923

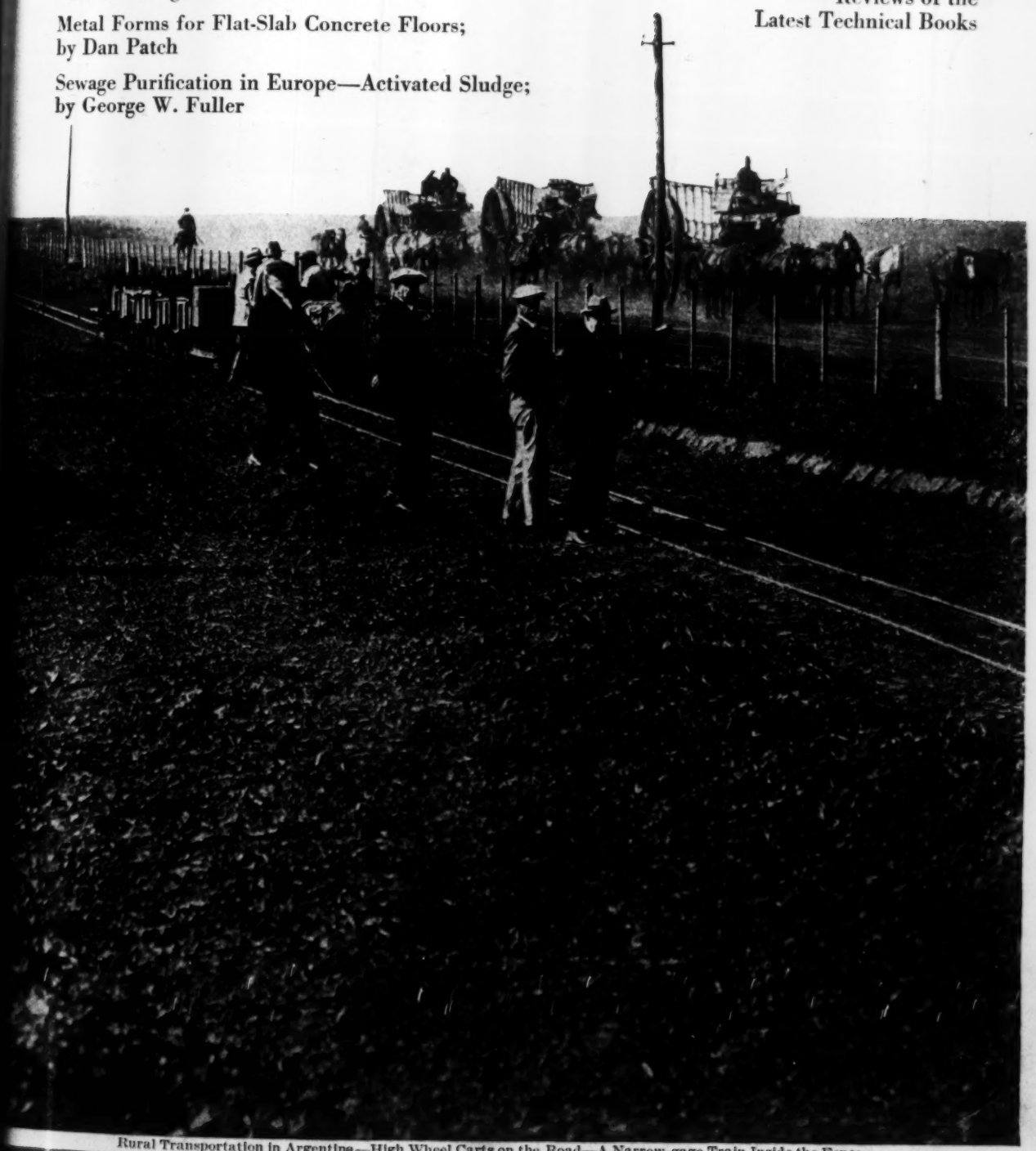
Engineering News-Record

Design of the Huge Municipal Stadium on the Chicago Lake Front

Metal Forms for Flat-Slab Concrete Floors; by Dan Patch

Sewage Purification in Europe—Activated Sludge; by George W. Fuller

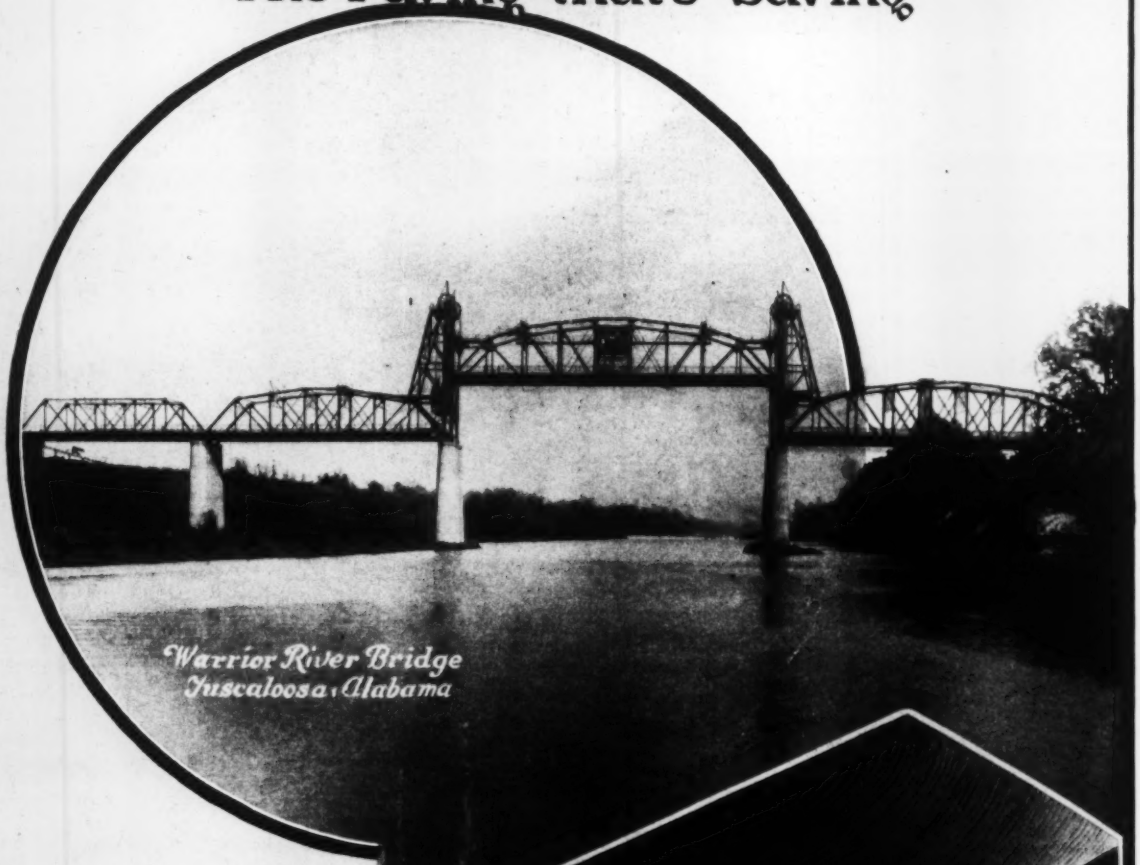
Engineering Literature; Reviews of the Latest Technical Books



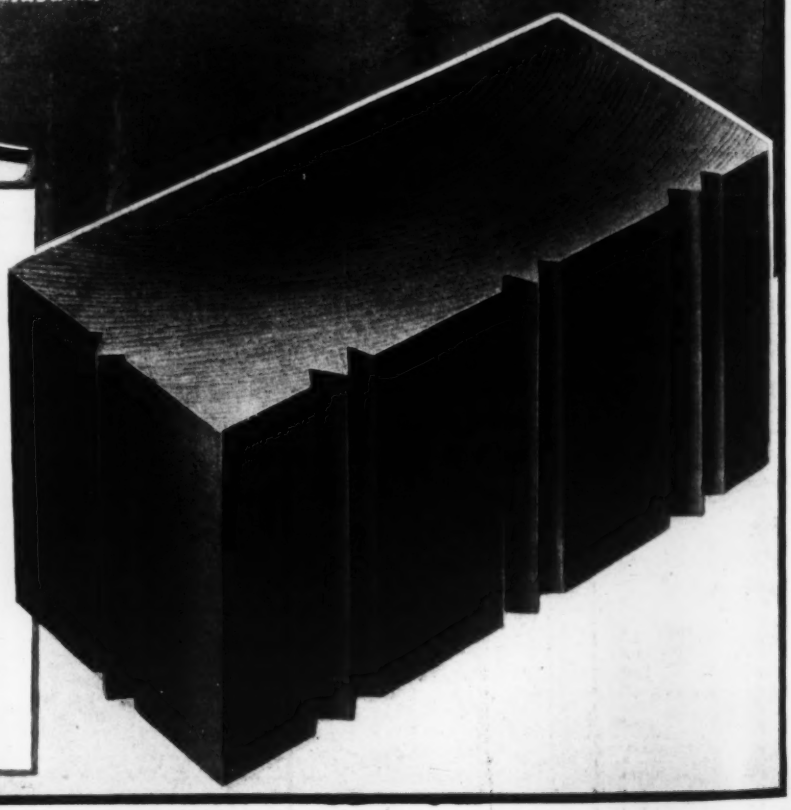
Rural Transportation in Argentina—High Wheel Carts on the Road—A Narrow-gage Train Inside the Fence

KREOLITE KOUNTERSUNK - LUG - BLOCKS

"The Paving that's Saving"



Warrior River Bridge
Tuscaloosa, Alabama



Kreolite Kountersunk Lug Wood Block Bridge Floors are laid with one thought uppermost—**to endure.** Thoroughly impregnating the well seasoned blocks with Kreolite Preservative Oil, by our own patented process, absolutely insures them against decay.

Only the tough end grain of the wood is exposed in our method of laying. The exclusive countersunk lug construction of Kreolite Blocks allows openings between them. When these are filled with Kreolite Pitch the blocks are keyed together as a solid unit, while ample provision is made for expansion and contraction between the joints.

Write for detailed specifications and information

The Jennison-Wright Company
79 Kreolite Bldg., Toledo, Ohio

A Consolidation of Engineering News and Engineering Record — McGraw-Hill Company, Inc.—JAMES H. McGRAW, President

ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

Volume 90 — NEW YORK, FEBRUARY 15, 1923 — Number 7

No Isthmian Canal Now

IF any engineer is counting on getting a job helping to build the new Isthmian canal that Washington is discussing in cabinet and press he had better find a fairly long stop-gap engagement to take care of the next dozen or so years. Statesmen have to look a long ways ahead, much longer than engineers. And the current canal agitation lies more in the field of diplomacy and statecraft than in that of engineering. The Panama Canal, as was pointed out in these columns some months ago, is good for another thirty years provided certain precautions are taken to insure an additional water supply and even then its capacity can be increased by parallel locks at a tenth of the cost of a new route. With the half dozen national projects crying for execution with federal funds, projects which will both create wealth and protect life and property, this is no time to contemplate the billion dollars that a new Isthmian canal might well cost.

Activated-Sludge Tendencies

ACTIVATION by paddles or some other mechanical device rather than by compressed-air diffusion will doubtless be given more attention in American activated-sludge projects hereafter than it has in the past. This conclusion rests on the observations and opinions recorded in Mr. Fuller's concluding impressions of sewage-works in England, concerned wholly with activated-sludge plants and studies in that country and on the strong expressions in favor of mechanical agitation contained in the second of two articles on the activated-sludge process by C. Lee Peck soon to appear in this journal. That England is much further in the lead of America as regards practical work in activation by mechanical means than in pre-treatment of sewage before activation may be inferred from Mr. Fuller's remarks on this subject. The growing use of pre-treatment in both countries is a new illustration of the seemingly inevitable division of labor in sewage treatment wherever effluent of high character is the aim. In the matter of sludge dewatering at activated-sludge plants it would appear from Mr. Fuller's impressions that far less has been done, or for that matter even attempted, in the United States than in England. On dewatering and sludge utilization the forthcoming article by Mr. Peck will afford information and stimulus.

Public Economy

THERE is satisfaction in reading a story of how a bridge more than 600 ft. long was replaced after its washout by a temporary wooden bridge at a cost of $16,000, which expenditure will serve for ten or fifteen years; the operation is described on p. 302 of this issue. In another part of the country last summer a similar piece of temporary bridging consumed the rather startling sum of about $300,000. Though there were complicating items, such as a draw span, and different proportions and load capacities, that affect the comparison, it is nevertheless true that a taxpayer—a "common citizen"—will find it hard to understand. One good reason for the low cost of the South Dakota bridge may be found in the fact that money was scarce: if anything at all was to be built, it had to be built as cheaply as possible. Money can be made to go far if it must be husbanded, as many engineers know from their own experience. In the case of the other bridge there was no such pressure, for money was plentifully available. Whatever may be the reason for the difference in cost of the two bridges in question, it is fairly sure that when the engineering department of any community spends money wastefully or lavishly it will arouse dissatisfaction and feelings of distrust in the public, while the thrifty use of public money will earn approval and strengthen the public confidence.

Breaking the Budget

IT HAS always been clear that the federal budget would be successful only insofar as it was supported by Congress. The minute Congress begins to appropriate more than the maximum allowable amounts the budget makers decide upon that minute the morale of the budget begins to break down and the return to the free-for-all appropriation system is foreshadowed. As was to be expected, the first attack on this year's budget comes with the rivers and harbors bill, commonly known as the pork-barrel. Senators and representatives alike were unable to resist the local demands which increased a budget estimate of $27,000,000 to a total of $56,000,000. In explanation it is claimed that the larger amount is merely that recommended by the Army engineers and that it is necessary to insure the proper carriage of water-borne freight. Both claims have shallow foundations. The Army engineers merely list expenditures that can well be made—regardless of how much money the government has to spend. As to water transportation, only the main harbors and one or two of the large rivers are necessary to satisfy the demands of commerce. They are cared for by the smaller sum; the rest goes merely to prospective benefits which may or may not be realized, and which in times like these of national financial stress are, to say the least, expensive experiments.

A Short Step on a Long Road

PASSAGE by the House of the British debt refunding bill with a spirit that bids us anticipate similar action by the Senate may be viewed either from the standpoint of the principals to the transaction or from that of the rest of the world. With respect to the former the event is of far-reaching importance. Acceptance of this settlement by the Senate and its final approval by the President will mark the funding of the largest international debt ever contracted. To the United States it will mean a setback to the agitation for the cancellation—in part, at least—of the European debts and will establish a standard by which to adjust the obligations of other

nations. For Great Britain it will halt the accrual of interest charges at the present high rates and effect a new deal that has been accepted as fair by both parties. It seems easy, however, to overestimate the effect of the settlement on the rest of the world. To be sure, it is the first step toward a readjustment of the war-debt tangle, but it is an obvious and a discounted step. No one ever has doubted that Great Britain would measure up to her proud standard of a "debt-paying nation." And to be sure also, the settlement may be taken to clarify the attitude of the United States toward the rest of the European debts. But in the light of France's position that she can consider modification of the German reparations only in proportion as her own obligations may be forgiven, it is difficult to discern much promise in this development. For until consideration of the reparations problem has been dragged down from the murk of political prejudice, sheer guesswork and arbitrary opinion to a basis of ascertained fact and reasoned judgment, there is small hope of general progress toward economic peace and stability in Europe.

A Necessary Quality

MOST precepts to insure success in life are variations of the basic principles of conduct set up in age-old texts. The Bible is full of them, Bacon and Ben Franklin amplified them and today they appear in modern dress in the inspirational magazines out of the mouths of those who by their position may appear as instructors of youth. Once in a while, though, a new thought appears. One such was gleaned last week from a talk to some McGraw-Hill men by E. M. Herr, the president of the Westinghouse Electric and Mfg. Co. Referring to an old chief, Mr. Herr said that he possessed in a remarkable degree the most necessary quality for a good executive; he was able to give an order so clearly that the subordinate could not possibly misunderstand what was wanted. The subordinate might not be able to do what was expected but he would know quite unmistakably what that thing was. Some years ago Elbert Hubbard immortalized one who had carried a message to Garcia by contrasting him with the average inefficient who can never properly execute an order. Mr. Herr's thought implies that this incapacity may not always be the fault of the subordinate. An obligation for clear statement—which presupposes clear thinking—rests on the superior. The engineer may take this rule to heart, for even in his more elementary capacities he has to give orders. If he would have them properly executed let him study to make them unmistakably clear.

River Sanitation Districts

THE Connecticut proposal to cope with stream pollution by a combination of state and district control is logically sound. Such method by itself has precedents. It is the combination, at least such an extensive one as seems to be contemplated, that is novel. What happens without central control is sufficiently illustrated by Connecticut itself, where stream pollution has gone so far as to be a serious problem. What state control can do is shown by a number of our states, but for the most part they have been vested with but little power to hold industrial wastes in check, and these are perhaps the most serious problems in Connecticut. District agencies, with jurisdiction over one or more entire stream drainage areas, have functioned successfully in the United States, England and Germany for years past. Here, in Germany, and to some extent in England, these river sanitation boards have been created for the construction and operation of works designed to remedy stream pollution nuisances; but England affords notable examples of river conservancy boards whose function is to control pollution by pressure on municipalities and industries rather than by building joint disposal works. Such control is almost if not quite unknown in the United States. Two weeks ago it was commended for American consideration by George W. Fuller in the first of his series of impressions of British sewage-works now running in our columns. The report of the Connecticut Commission to Investigate the Pollution of Streams, noted last week, is so sketchy as to leave uncertain the exact relation between the proposed Water Conservation Commission and the drainage district boards, as well as how the latter are to be created and financed and their exact function and powers. Enough is said, however, to make it clear that the general plan deserves careful study in Connecticut and elsewhere as also the elaboration of details suited to local needs which should take into account political as well as physical conditions.

Technical Direction of Highways in Danger

MORE changes in state highway department heads are being made this year than in any year since the disturbed period of war times. New York, Pennsylvania, New Jersey and California, all major road building states, will start the construction season of 1923 with new directing officials. Except in Pennsylvania, where the deaths of the former commissioner and chief engineer made necessary new incumbents of these offices, all the changes are the outcome of the election results of last November. They are acts prompted primarily by political expediency even though the men appointed and the administration reorganizations predicted by their appointment offer no compelling cause for criticism. This is a disquieting circumstance.

Regarding highway improvement as a continuing business of great magnitude, and it must be so regarded or we shall commit a vital error of foresight, changes of directing officers and of official policies of demonstrated efficiency, expect for the soundest engineering and business reasons, is courting danger to highway development as a state and national enterprise. It has been somewhat notable in public works engineering history that the technical heads of public roads work have been comparatively permanent. A higher appreciation of responsibility and a greater pride in vocation have resulted and are being demonstrated by research and practice that are putting highway engineering and highway transport in America on a higher plane than they occupy in any other country. The road using public cannot afford to have this development placed in danger.

A situation exists which is dangerous. It does not arise wholly from the disposition of partisan politics to make public roads work subservient. The mood of the people is critical of centralized engineering direction of highway improvement. Shifts of directing heads of departments with all the loose talk of inefficiency and graft that is the invariable political smoke screen confirms the people in their notion that the modern practice of centralized engineering direction is nowise more efficient and honest than old time non-technical county or township direction, and they are wondering if it will

not cost them much more. A score of state departments this winter are confronting this attack in their legislatures and by some it will not be easily withstood.

All these happenings indicate clearly the necessity that devolves upon state and federal highway departments and on national associations of industries collateral to highway improvement, of selling in season and out the vital fact of the technical nature of the highway problem. The first lesson is that highway development is a continuing business. The problem of road construction is followed by the equally large problem of road maintenance and this by the greater and more intricate problem of highway transport. Each problem, moreover, is first and last essentially technical. These facts must be got to the consciousness of the road building and road using public and this is a task which the highway engineer and the highway transport engineer might well place above all the many tasks which devolve upon them.

A Measure of Service

IN THE long run the success of the engineering profession depends upon the trust which the community places in engineers even more than upon the competence of engineers themselves. To hold that trust is of first importance. From this requirement flow the commandments of professional honor and the principles of engineering ethics. In particular, it gives us the true statement of the engineer's responsibility in the execution of his work. It establishes that whose want is often seriously felt: a measure of adequate engineering performance.

In these days of change in the conditions of engineering organization, the question of what obligation of performance is involved in a given engineering undertaking presents itself more and more often as a troublesome problem. Because engineering services are not subject to description and specification, they remain undefined, and the terms of the contract existing between the engineer and his employer are subject to the engineer's own interpretation alone. The execution of the contract is left without supervision, and there is no check on when its performance is complete and adequate. Professional self-respect and conscience furnish the only control. But if competition brings bargaining for engineering services, and if price tends to become a deciding factor, it becomes desirable to have a more certain guide than that of conscience, and to appeal to some tangible measure of adequate performance. That measure is furnished by the obligation of carrying out each item of engineering work in such a way as to perform to the full those obligations which the community, in its own (not the engineer's) conception of the profession's responsibility, imposes.

The engineer who falls short in performance strikes a blow at the strength and good repute of every one of his professional brethren, greatest as well as least. The world depends on the engineering profession to do its constructive work, and it judges engineers as a class according to the excellence with which this work is done. It takes no account of whether payment was disproportionately small or whether monetary expediency counseled a narrow view, but looks only to the lasting result. If it finds the result inadequate or false, it inflicts the penalty of loss of trust upon that class which it holds responsible.

And the world, we must bear in mind, has a long memory for some things. Though the shortcomings of a plan or a structure may not appear until years or generations after it was conceived, yet blame and ridicule are turned against the profession whose members did the work. Even today we bear the burden of errors and delinquencies committed by earlier engineering generations.

Professional honor and ethical principle, we have said, are shaped by the necessity of holding the community's faith and trust. This obligation may appear intangible. It can be translated into more definite terms, however, when it is applied to specific engineering activities. The best professional standards exemplified in the practices of engineers today are such as satisfy the community obligation most completely, we believe. Ultimately such standards will be written down to form a basic declaration of what constitutes full engineering performance.

City Management and Manners

EVERYONE keenly appreciates that municipal thrift is sorely needed, all over the country. In consequence any determined effort toward economy is sure to enlist general support and approval. What has been going on in Cleveland during the past year—the administration's drive for reduction in city expenditures to get out of the red ink—is commendable and has won merited praise. But the Cleveland movement now seems to be taking a sinister turn, threatening to destroy all that has been achieved in the direction of economy, by disruption of the city's working organization through ill-advised and ill-mannered conduct on the part of the mayor. It now affords a warning example of how city government may be wrecked rather than a model of how it can be reformed.

Some of the events of the developing Cleveland situation are reported from local correspondence in the news pages of this issue. They exhibit a lack of appreciation of technical needs and functions in city administration, which, however deplorable it may be, is not unnatural outgrowth of ordinary ignorance about engineering matters. Up to the present no permanent harm has been done the city by this lack of appreciation, and it is not necessarily a critical element of the situation. But when superadded to ignorance, the methods of a drill-sergeant are brought into play by the mayor in dealing with his fellow-officials and aids, municipal government is bound to go to pieces. The resignation of the utilities director, A. B. Roberts—who by the way is an engineer, recommended for office by the local engineering society, and has been a strong point of hope on the part of those who looked for real improvement in the city's government—represents the start of this disintegration.

Government is a business, in short, and good government demands methods comparable to those of good business requirements. Just as a business cannot prosper that is not built on the basis of decent conduct between man and man, so government under the same conditions cannot succeed. This elementary principle, illustrated anew in Cleveland, is the warning lesson of Mayor Kohler's police-chief government. However badly we may need municipal reform and waste-elimination, we cannot hope to attain it by disregarding ordinary business decencies. Roughneck manners will not reform city management.

Chicago Building Huge Public Stadium on Lake Front

Concrete Structure with Benched and Terraced Grandstands and Large Halls for Athletics, Parades and Exhibitions—Beam and Girder Frame in 48-Ft. Lengths

A PUBLIC STADIUM of reinforced-concrete construction, with an arena having the unusual length of 1,014 ft. and with side structures 860 ft. long which not only form grandstands but also provide large halls for exhibitions and indoor sports, is being built in the new portion of Grant Park, Chicago, by the South Park Commission, as part of the extensive improvements along the lake front. Its total cost will be about $4,500,000. The stadium has the very unusual feature of providing for large parades, pageants, military manoeuvers, concerts and outdoor winter sports in addition to the usual athletic sports. In order to provide for evening use an extensive system of general and decorative electric lighting is included in the project.

In plan the stadium is U-shaped, with an amphitheater at one end, although five of the six competitive designs were based on a closed oval plan. As shown by the general plan, Fig. 1, the sides are parallel and not of the horseshoe arrangement used in the Ohio University stadium described in *Engineering News-Record*, Oct. 19, 1922, p. 640. For 375 ft. from the amphitheater the side structures will have tiers of benches extending to the full height. For the remaining 485 ft. there will be a lower tier of benches backed by a series of terraces, the purpose of this terraced arrangement being to provide for temporary tiers of additional seats when required.

These two types of cross-section are shown in Fig. 2. At present the masonry work of the amphitheater and the terraces will be omitted. Earth embankments will be built on their sites, with surfaces sloped and turfed or held in a vertical face by timber retaining walls where the slopes would encroach upon the present buildings.

Governing factors in the design were specific conditions as to minimum length and main elevations, as well as the dimensions of the site. Limitations of height made it impracticable to consider the use of double-deck stands and also controlled the pitch or slope of the single-deck structures, so that this pitch is not as great as might have been desirable for the most advantageous lines of sight. These height limits also made it necessary to use the maximum available length in order to obtain the required seating capacity.

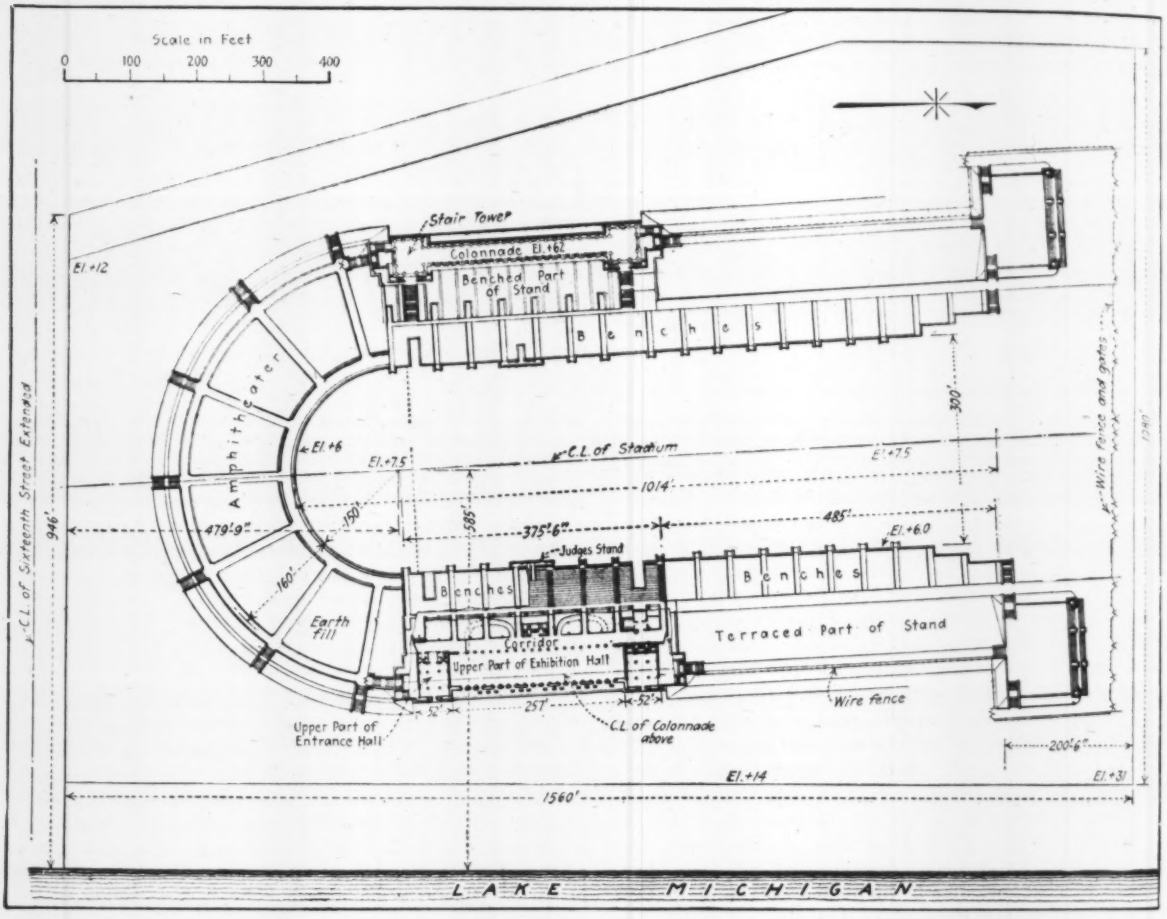


FIG. 1—PUBLIC STADIUM IN GRANT PARK, CHICAGO, COMBINATION EARTH FILL AND CONCRETE FRAME

The 300-ft. width of the arena is governed by the sight lines and by the athletic requirements. It is made up of a standard 160-ft. football field, having on each side a 20-ft. safety zone for the players, a 30-ft. running track one-third of a mile long and a space of 20 ft. between the track and the front wall of the stand. It was not practicable to provide space for a baseball field, but football was considered the sport of most importance, with track athletics ranking second. In the complete scheme the benches of the two side structures and the amphitheater will provide seating

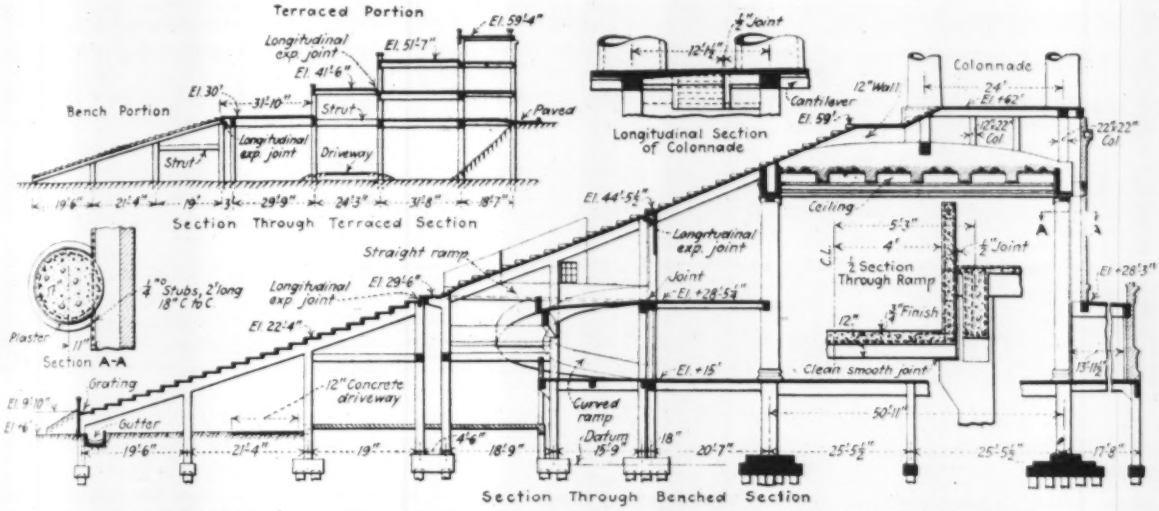


FIG. 2—SECTIONS THROUGH BENCH AND TERRACE PARTS OF CHICAGO LAKESIDE STADIUM

capacity for 60,000 persons and temporary seating for 40,000 can be arranged on the future terraces. In general dimensions the stadium will have an extreme length of 1,400 ft., a width of 700 ft. including the side structures, and an area of thirty-five acres of which seven acres will form the arena.

Foundations—The site is made land, reclaimed by filling along the lake shore, the fill having a minimum depth of about 22 ft. Below this is blue clay and hardpan. Wood piles 60 and 65 ft. long, driven into the hardpan, will carry the buildings, since the loads are not large enough to warrant the expense of sinking concrete piers to rock at a depth of 80 to 90 ft. A bearing capacity of 15 tons per pile is assumed. Combined footings are used where the loads are light and the column spacing is small. Special foundations for light loads are avoided in some cases by carrying these loads into the framing. For example, the judges' stands are supported by cantilevers from the main framing. The earth embankments used temporarily at certain portions, as noted above, are expected to reduce the cost of future permanent work, since these embankments will become sufficiently stable and compact to permit the concrete structures to be built directly upon them. This plan will avoid the heavy future expense of driving piles through the embankments to solid material and making deep excavations for footings and foundations.

Buildings and Structural Design—The two side buildings for the grandstands will form inclosed structures of approximately triangular cross-section, each surmounted at its highest point by a colonnade. Numerous side entrances will give access to the main exhibition hall, El. 15, at the opposite side of which are stairs and curved ramps leading up to a circulation corridor at El. 28.5. In the main towers at each end will be other ramps and stairways which lead from the 15-ft. level to the corridor. From this corridor straight ramps at frequent intervals will lead into the grandstand. The grades of ramps range from 1.75 to 2 in. per foot.

Reinforced concrete was selected for the framing, floors and benches, as the loads and spans present no particular difficulty, while structural steel would have to be completely fireproofed to meet the requirements of the city building ordinance. Artificial stone will be used for the exterior finish and decorative work. It will be mainly in precast slabs and blocks erected like cut stone masonry, but at certain points it will be cast in place and then carved or worked in the same way as stone.

Poured concrete walls will be 6 in. and 8 in. thick, reinforced both ways and in both faces by ⅜-in. bars of 18-in. spacing. Precast blocks for the wall facing will weigh 56 and 66 lb. per square foot for 8 in. and 12-in. thickness. Curtain walls supported on the framing will complete the inclosure. It was planned at first that the ornamental columns of the colonnade would be poured in place, but instead they are being precast in sections 5 ft. high, with a minimum thick-

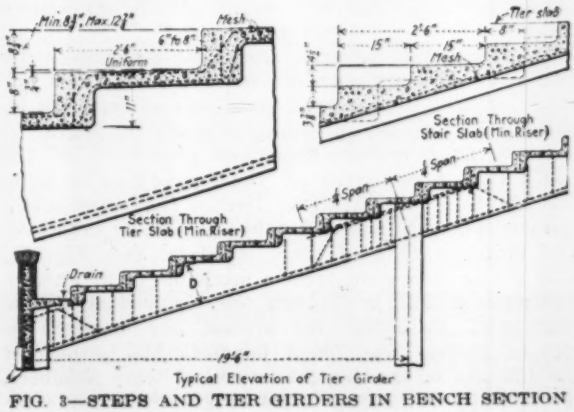


FIG. 3—STEPS AND TIER GIRDERS IN BENCH SECTION

ness of 5 in. for the shell. A concrete slab roof with asphalt roofing will cover the colonnade and that portion which is visible will be finished with ornamental clay tile.

The minimum section for main columns is 16x16 in. For long unsupported lengths between floors the columns are braced by tie-beams or struts at intervals of approximately twelve times the column diameter. No

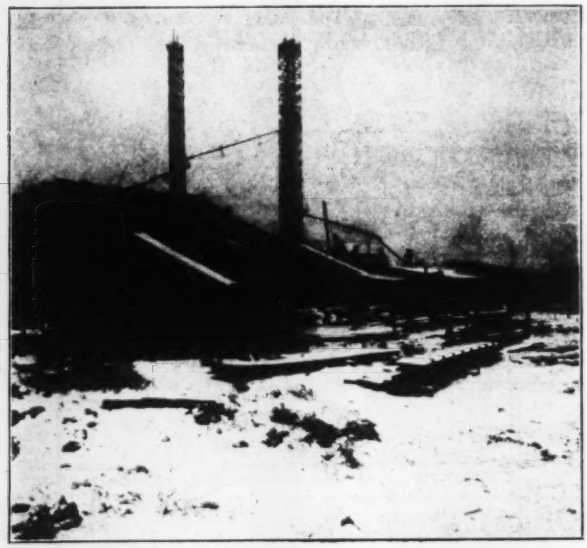


FIG. 5—BEGINNING GRANT PARK STADIUM, CHICAGO

diagonal bracing is introduced, since ample stiffness in both transverse and longitudinal directions is provided by the bench construction and the walls.

Floors and Beams—Floors are of the beam and slab type, with fireproofing 2 in. thick on beams and 1 in. on slabs and tier framing. Slabs up to 4½ in. thick have continuous bar reinforcement, with alternate bars raised over the supports. In slabs of greater thickness and in beams and girders, alternate bars are bent up at the fifth point and extended to the quarter-point in the adjoining span. Beam depth is limited to one-twelfth the span to prevent excessive deflection. Where wire mesh is not used as slab reinforcement, temperature steel is provided by ⅜-in. bars of 18-in. spacing at right angles to the main reinforcement. Typical girders and beams for the benched portions of the grandstands are shown in Fig. 3.

Live-loads as follows were used in the design: For ramps, bridges, aisles and stairs, 150 lb. per square foot; for benches or seat tiers, 100 lb.; for framed interior driveways, a motor truck with 6-ton maximum axle load. These loads were reduced 50 per cent for columns. The live-load per lineal foot of bench 30 in. wide is 250 lb. No allowance is made for impact.

Bench Construction—Elevations prescribed by the South Park Commission for the top and an intermediate point of the structure limited the cross-section and controlled the rise of benches, as already explained. The uniform width of tread is 30 in. (see Fig. 3), with a rise increasing from a minimum of 8¾ in. to a maximum of 12⅞ in. to suit the required sight line clearances. A design for precast tier members or stepped girders was found impracticable because of the difficulty of erecting the large and heavy members, the difficulty of making forms sufficiently accurate for a close fit, the probability of leakage and the lack of economy in the design.

The slab is 3 in. thick, with mesh reinforcement weighing 22 lb. per 100 square feet. Joists or risers are 6 to 8 in. wide and 11 to 15½ in. deep, with one straight bar and one bent bar in each joist. The width of joists is governed by the shear.

Wood seats are provided on all tiers, the risers being too low for convenient seats. Fir planks, 2x12 in., form the seats and are supported on creosoted oak blocks secured to anchor bolts in the concrete. To shed water from the tiers the cascade drainage system is used, with the slabs and tiers pitched toward the arena. In the lowest tier is an iron grating over a concrete gutter. (See Fig. 2.) A slope of ¾ in. in 30 in. for each bench provides for a quick runoff and eliminates seepage. The concrete of the seat tiers is to be finished with a wood float and no top dressing will be applied.

Expansion Joints—As a preliminary to the design an examination was made of several existing structures. It is stated that this showed numerous evidences of injury due to expansion and contraction movements, not only in the way of cracks but also critical failures in the framing which have involved considerable expense for repairs and maintenance. Sliding joints usually had failed to work, with the result of broken ends of beams and brackets. Mastic filler had been squeezed out in hot weather and failed to return when cooler weather caused the joints to open. In other cases the rigidity of the filling or the accidental presence of pebbles in the joint caused the edges of the concrete to spall. A concrete stadium built as a monolith was found to have several cracks serving as expansion joints. On the basis of this investigation it was decided to omit all joint filling and to reduce sliding joints to a minimum, using them only where the loads are light.

An approximate variation of 9 in. in the 1,400-ft. length of structure is provided for by transverse joints ½ to ⅝ in. wide, placed about 48 ft. apart. There are also two longitudinal joints somewhat further apart.

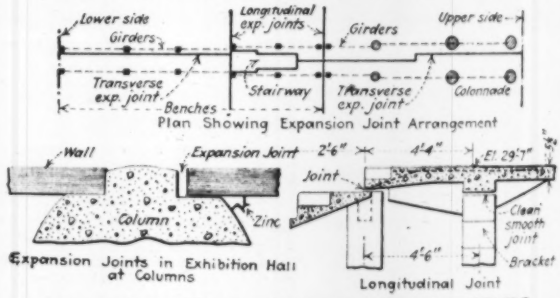


FIG. 4—EXPANSION JOINTS, PLANS AND DETAILS

In the stands the transverse joints are placed at the sides of stairways in order to be inconspicuous. The general layout of joints in the grandstands and details of some of the joints are shown in Fig. 4. Gutters are placed generally under all expansion joints in benches, decks and roofs in order to prevent the nuisance of dripping water. These gutters were omitted where the detail of concrete at the joint was such as to prevent entrance of water. Since no filler is used the joints may be easily inspected and cleaned.

To carry the transverse joints from foundation to roof without causing unsightly appearances required

considerable ingenuity on the part of both the structural and architectural designers, especially as these joints occur through halls, coffered ceilings and high walls. Architectural considerations made it impracticable to carry expansion joints on a straight line, offsets being introduced to bring them to places where they might be concealed. In beamed ceilings the joints follow the edges of beams, requiring either a suspended ceiling or cantilever construction from an adjacent beam. In partitions a clean vertical joint is made and is covered with a thin strip of zinc. On exterior walls the joints are carried down along reveals or pilasters where possible. On flat surfaces they follow the vertical and horizontal joints. In the roof, the joints will have metal strips under the asphalt covering, to prevent leakage. The curved ramps are designed to stand free from the structure proper, resting on brackets and beams provided with lead bearing plates.

Where sliding joints were unavoidable the reactions were made as light as possible and freedom of movement will be assisted by the use of two ½-in. lead plates separated by a sheet of paper soaked in lard oil. Cantilever construction was used at these joints where possible, together with split columns and double beams forming independent rigid frames.

Utilization of Interior Space—The value of the large volume of inclosed space beneath the stands was so apparent, especially in view of the unusually varied purposes of the structure, that the plans were prepared with special attention to utilizing this space effectively. Three great halls with an unobstructed width of 50 ft. and an additional space of 25 ft. on one side are provided, two under the grandstands being about 260 ft. long, while the third under the future amphitheater will make an aggregate length of about 1,000 ft. These halls will serve for exhibitions and similar purposes.

Under the lower part of each stand is a 12-ft. concrete driveway nearly ¾ mile long, with 11 ft. headroom and this is flanked on each side by unpaved vacant space which will be available for organizing parades or preparing decorative floats. Under the terraced section of the stands there will be an additional 16-ft. driveway (Fig. 2). In addition, extensive provision is made for smaller halls, locker rooms, baths, hospitals, toilet rooms and public comfort stations.

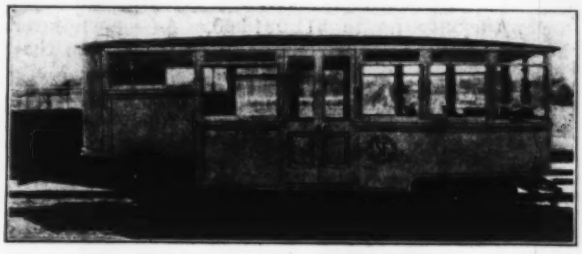
Electric Lighting—Since this stadium has the unusual feature of providing for night displays both outdoors and indoors, a comprehensive electric system will be required. This is to include 500 kw. for general lighting, 500 kw. for flood lighting, 250 kw. for stage lighting and 260 kw. for power. Duplicate cables carrying 12,000-volt three-phase current will lead into a main transformer vault with 2,300-watt distribution thence to six smaller vaults. Flood lighting as planned for the arena, 1,014x300 ft., is believed to be the largest installation of its kind. For this purpose there will be 336 lamps of 1,500 volts, or 1.65 watts per square foot. Some of the projectors will be mounted on the frieze of the colonnade and others on twenty-two removable posts with ten projectors to each post.

Designers and Builders—Competitive designs were submitted by six Chicago architectural firms, by request of the South Park Commission. The award was made to Holabird & Roche, who thus became the architects of the work by the terms of the competition. The structural design was prepared under the direction of H. J. Burt, consulting engineer for the firm. Information for this article has been taken in part from a series of papers presented to the Western Society of Engineers by Mr. Burt and by A. M. Korsmo, J. E. Sansberry and F. A. Byrne, as his assistants. The contract for foundations and superstructure has been let to the Blome-Sinek Co., Chicago. It is expected to have the main part of the stadium completed by the fall of 1924, but the amphitheater and certain other features will be left until such time as the South Park Commission has funds available. The cost of work under contract is $2,500,000 and the total cost of the entire project is estimated at $4,500,000.

Gasoline Rail Car of New Design on California Railway

A GASOLINE rail car having several new and distinctive features has recently been delivered to the Hetch-Hetchy Ry. at Groveland, Calif. The car complete weighs about 10,400 lb. and makes 8 miles per gallon of gasoline. It seats thirty passengers and may be built for either narrow or broad-gage railroads.

On the Hetch-Hetchy road it negotiates a 5 per cent grade 12 miles long with numerous 30-deg. curves at



NEW GASOLINE RAIL CAR

a speed of about 27 miles per hour. By placing the motor to the rear of the driving wheels all revolving parts in front of the rear axle have been eliminated. This permits a very low-hung car and eliminates motor noises, smoke, and gasoline odor. It makes possible also a greater passenger seating capacity without lengthening the wheel base of the car. Vibration has been eliminated and traction increased by suspending the motor on coil springs directly over the rear axle on one end of a sub-frame.

The subframe makes one-half of the complete truck, as it has a swivel bolster built in the main frame so that it will turn at curves, thereby eliminating flange wear and relieving side thrust. The car has been invented and patented by A. R. Meister and was built by the A. Meister Sons Co. of Sacramento, Calif., at a cost which is given at $8,500.

New Zealand's Extensive Power Plans

The proposed hydro-electric development in New Zealand involves an expenditure of $60,000,000 and is to be spread over a period of ten years, states Consul General David F. Wilber, Wellington, in a report to the United States Chamber of Commerce. Besides lines already under construction there will be large main works at Lake Waikaremoana, and lines from Lake Coleridge will be extended into Otago and North Canterbury and from Mangahao will reach to Wanganui and Napier. There will be smaller developments in the South Island.

Award Made in Toronto Street Railway Valuation

Settlement of Payment for Taking Over System Decided at Sum More Favorable to City Than Company

By P. W. Greene
Toronto, Ont.

On JAN. 31 of this year, the award of the board of three arbitrators appointed to determine the amount to be paid by the city of Toronto for the property of the Toronto Railway Co., which the city took over on Sept. 1, 1921, was announced. The city acquired this property upon the expiration of the thirty-year franchise on the above-mentioned date, and the system has since been operated by a municipal commission known as the Toronto Transportation Commission, which has already spent many millions upon the rehabilitation of the property.

The board set a valuation of $11,188,500 upon the railway, and ruled further that the city should pay interest upon this amount from September, 1921, to the date of the award, at the rate of 5 per cent, which amounts to an additional $792,500, bringing the total cost to the city up to $11,981,000. As shown later this is nearer the city's contention of value than that of the company.

The report was not unanimous, Sir Adam Beck, the city's representative, dissenting. He stated he could not concur with his colleagues as to the general method of valuation adopted, the necessity for the city taking over certain disputed properties and the extent of the allowance for obsolescence. He did not, however, submit any alternative figure.

Roughly speaking, the property consisted of 139 miles of single track, with the necessary trolley wire, overhead and underground distribution system; 830 passenger cars; five carbarns; three storage batteries; a steam plant, not in operation but for which the company claimed "stand-by" value; car building and repair shops; five substations and certain real estate which the city objected to taking over.

In presenting its case to the board, the company contended strongly for a valuation of the above property based on reconstruction cost new less an allowance for depreciation, using average prices for a three-year construction period, ending Sept. 1, 1921. The city opposed this method on the grounds that it included the years of 1919-20, when prices were abnormally high, and contended that it would be grossly unfair were it compelled to pay for the railway at those extremely inflated prices, and on its part; submitted a valuation on what it termed the "trend basis." This valuation was also based on reproduction cost new less depreciation, using however prices as they would have been in 1921, assuming there had been no war and that the normal trend of pre-war prices had continued undisturbed through the war years to 1921.

Both sides also submitted alternative figures using prices as of the date of taking over, that is September, 1921, but in each case contended that the methods mentioned above were what they considered to be the equitable methods.

Price Basis Adopted—The board actually adopted this 1921 price basis, stating that the three-year period as advocated by the railway company would in this case have thrown an unfair burden upon the city, due to the abnormal prices of 1920. At the same time, referring to the "trend basis" as advanced by the city, in the words of the award they stated—"We are unable to give weight to this contention, which in effect, disregards entirely current prices and rates of wages. Value (as set forth in the agreement) means value in lawful money of Canada at the time the valuation is made, not lawful money of Canada as of an imaginary period. We are unable to find anything in agreement or in judicial decisions sustaining this view."

While this matter of the basis of valuation to be adopted was undoubtedly the most important point of principle which the arbitrators were called upon to decide, the wording of the original agreement between the company and city was the source of some other very contentious points. It stated that the board appointed to decide the value "were to consider and award only value of said several particulars (property, plant, equipment, etc.) to the city at the time of the arbitration, having regard to a railway of the best kind and system then in operation and applicable to said city," and further, that, "rights, privileges, profits, dividends, etc., were not to be considered, but the arbitrators were to consider only the actual value of the actual and tangible property necessary to the operation of the railway." The phrases "best kind and system" and "necessary to the operation" resulted in lengthy legal arguments, and introduced the questions of obsolescence, and the necessity or otherwise of the city taking over certain parts of the property which they wished to reject on the grounds that they were "unnecessary for the operation of the railway" or were obsolete, not coming up to the requirements of a railway "of the best kind and system then in operation."

The principal items in dispute in this connection were the three storage batteries, and the old steam plant. Numerous expert witnesses were brought in, and a mass of evidence was submitted, to prove the necessity or the reverse, of these two sections of the property. The board decided that the city should take over the storage batteries at a valuation of $338,500, the company having asked in the neighborhood of $800,000. With regard to the steam plant, the award specifies that the city shall take it over, but sets a scrap value upon it, stating as the reason that the city has already willingly taken over the half of the building containing certain electrical equipment, and they could not, therefore, reasonably reject the remaining half of it.

The board also ruled that the city did not have to take the original three-story head office building; some disputed sections of real estate, certain cars which the city claimed were obsolete, and the majority of the stores and patterns.

General Overheads—One of the most interesting points arose in connection with the general overheads to be allowed. The arbitrators recognized only two items—engineering and superintendence, for which they allowed $375,000 and interest during construction, $525,000, making a total of $900,000 for general overheads. The company had claimed in all, approximately $3,300,000 under this heading, which included in the neighborhood of $1,530,000 for cost of placing property in operation; $680,000 for miscellaneous general overheads, such as taxes, insurance, legal expenses, and such like, and $165,000 for contingencies and omissions, but the board allowed nothing for these. While they

admitted that such allowances are frequently taken into account, they considered them as "intangibles" and, therefore, not capable of being included within the meaning of the words "actual and tangible property."

Nor did they, on the same grounds, allow anything for cost of raising the capital, the company's figure for which was $2,500,000 to $3,000,000.

Award Itemized—In setting out the award, the board was careful to state, in addition to the actual amounts to be paid, the figures it arrived at for the main subdivisions of the property on both the "three-year average" basis and the "trend basis," having in mind, evidently, the possibility of an appeal; in which case these figures might prove of great value and save endless duplication of work should its decision as to the proper basis be not upheld. Further, values were set for disputed properties which the board itself ruled as unnecessary to be taken over. Reasons were given for all conclusions arrived at by the board, and numerous legal precedents were quoted. Each of the main items of the property was dealt with separately, and detailed schedules were attached covering all the real and personal property, undisputed and disputed; so that the award was an extremely clear and comprehensive document, leaving apparently nothing not covered. It stated also that obsolescence had been considered where they thought reasonable. The main figures of interest are:

Amount of actual award based on 1921 prices	$11,188,500
Valuation by railway company on 1921 basis	21,000,000 approx.
Valuation by city on 1921 basis	7,000,000 approx.
Valuation by railway company on 3-yr. basis	22,000,000 approx.
Valuation by city on 3-yr. basis	5,000,000 approx.

Personnel—It should be noted that the railway company's three chief witnesses, mentioned below, each submitted complete appraisals, covering an inventory agreed upon with the city's engineers, the chief differences being in the prices used in parts of the property and allowances for overheads. These three appraisals all ranged about the figure $21,000,000 of the above table, which includes all disputed property as well as undisputed.

At the time of writing no definite announcement has been made, but it is generally believed that both sides will appeal to the Privy Council in London.

Among the prominent engineers engaged were Hagenah & Ericson, of Chicago; A. L. Drum, of Chicago, and M. E. Cooley, from Ann Arbor, Michigan, for the company. Jackson & Moreland, of Boston, were in charge of the case for the city, and were assisted by Prof. A. S. Richey, of Worcester, Mass., who valued the rolling stock. Numerous other prominent engineers were called in to deal with special features of the property.

The Board of Arbitrators consisted of Hume Cronyn, of London, Ont., chairman; Sir Thomas White, ex-Minister of Finance, at Ottawa, representing the railway company, and Sir Adam Beck, of the Ontario Hydro Electric Power Commission, for the city.

W. N. Tilley, of Toronto, was chief counsel for the city, and N. W. Rowell, for the company. Pierce Butler, now justice of the United States Supreme Court, also acted as railway counsel.

In view of this distinguished array of arbitrators, engineers and counsel, the extent and detail of the evidence submitted, and duration of the proceedings (the court actually sat on 156 days; 48 witnesses were called, and nearly 800 exhibits were filed), this case will be considered as one of the most interesting of the kind on record.

Refined Tar for Coating Cast-Iron Pipe and Fittings

By S. R. Church

Technical Adviser, The Barrett Co., New York City

Extracts from a paper read before the New England Water Works Association

TEN years ago I first gave some attention to the question whether or not there ought to be a specification for a refined tar product for coating cast-iron pipe and fittings, I found that at practically all the foundries crude coal tar was being used. The method of coating varied somewhat but was usually developed by experience and not marked by close control. I came to the conclusion that the coating could probably be improved by: (1) Closer temperature control of both castings and bath; (2) Adoption of some method for testing the consistency of the coating from time to time and keeping it uniform; (3) Specifications for the coating that would insure reasonably uniform consistency and freedom for excess water. It did not seem to me at that time that the last named requirement was of greater importance than the other two.

No doubt coating technique has been improved during the last ten years; most industries are making progress. I know that your association has been giving attention to the problem and that tentative specifications for pitch for pipe coating are under consideration.

You may ask: Is pitch a better material for coating pipe than crude coal tar? If so what should be the melting point of the pitch? What is the meaning or significance of "free carbon" in tars and pitches? Should the origin of the tar be specified—that is, gas works, coke oven, etc.?

The tars first used for coating pipe were horizontal gas-works coal tars. In the early days of gas making fire clay retorts were used and the first important change in the character of coal tar occurred when fire clay was replaced by silica retorts. With the latter, higher heats were employed and tar was produced of very high viscosity and high free carbon content.

The newer types of tar—coke oven, vertical retort and water-gas—are thinner and of lower free carbon content than the horizontal gas-works tars. Undoubtedly the best coating is not obtained when very thin tar is used. Crude water-gas tar or crude vertical-retort tar makes a very poor coating, lacking body. To obtain a coating having the consistency and covering power of a medium gas-works coal tar, most of the tars now available must be modified by distillation, or reduced to the proper consistency. Either coal-tar or water-gas tar may be reduced to any desired consistency but it is doubtful whether water-gas tar should be used for pipe coating as its resistance to chemical attack and its life under conditions of service have not been well established.

What happens when a hot casting is dipped in tar? The object of the process is to obtain a thin but complete coating that will dry in a short time, adhere strongly to the pipe, be resistant to abrasion and finally protect the metal from corrosion. If crude tar is used the heat is sufficient to drive off enough of the more volatile oils so that the remaining film or coating is pitch. If pitch is used to start with, either higher temperatures must be employed or a thicker coating will result. I do not believe there is any merit in a thicker coating per se; on the other hand a very thin tar may produce a coating so thin as to be non-protective and unduly brittle. I am inclined to the opinion that what is needed is a refined—distilled—tar with reasonable limits as to viscosity and free carbon. The viscosity limits should be specified at an elevated temperature, say 100 deg. C., approaching that of the bath.

What does free carbon signify? The term is a misnomer. Free carbon means matter insoluble on hot extraction with benzol. It is not "free carbon," but a mixture of difficultly soluble and insoluble compounds of high carbon content, but containing some hydrogen. Tar is a product of destructive distillation which means that the vapors distilled out of the coal are partially decomposed and the result is a mixture of hydro-carbons with some oxygen and nitrogen compounds

which were not present as such in the coal but are formed in the retort. "Free carbon" is an index of the amount of decomposition that occurs. Tar obtained from coal under conditions suitable for decomposition—for example, under high vacuum with rapid removal from the retort—would be entirely different from our commercial tar. It would contain a lot of paraffin compounds and phenols and would be thin and oily, with a very low pitch content.

"Free carbon" in the specification is simply a means of providing for tars that have been produced at neither too low nor too high heats. Lack of it indicates a thin tar of inferior covering capacity; too much, a thick material difficult to handle and settling out in the treating vessel or bath.

Apart from specifying that the tar should be obtained from the carbonization of bituminous coal, I do not believe that its origin need be specified if the proper limits for consistency and free carbon are arrived at. Uniformity is what is wanted and it is the tar distiller's job to produce that uniformity by selecting and combining his tars, and processing the mixture to obtain the desired product. The tar producer cannot insure this, and while tar from one source may run very uniform for a long time it may and in fact often does change profoundly without any warning as the requirements of coke and gas vary. It has been the history of material specifications that as we approach perfection the requirements for the finished product become more important than the question of where the raw material originated.

How to Develop Cost Curves for Building Estimates

Equation of Cost Curve for Given Type of Building Derived from Analysis of Estimated Costs of Three Buildings

By O. G. Wilbur

Building Pilot Engineer, The Baltimore & Ohio System, Baltimore, Md.

Copyright, 1923, by O. G. Wilbur

BUILDING unit cost curves can be very satisfactorily used in appraisal work, at a much reduced cost when a number of buildings of similar design and construction are involved. This method of appraisal affords an opportunity to compile data which might be applied as a "rule of thumb method" in appraising property where reasonably accurate results are required.

Studies of costs of various building materials and rates of wages for the various trades in the principal cities indicate that within certain zones but little variation in costs exists, so that by developing cost curves covering the various general types of construction, using unit costs representative of a certain territory, those curves might be applied anywhere within that territory and reasonable results obtained.

To develop a building cost curve applicable to the superstructure of a specific type of building, two or preferably three representative buildings are selected whose exterior and interior construction are comparable, widths and heights varying somewhat and lengths varying to a considerable extent. If three buildings are used, one should be selected whose dimensions are nearly an average between the smaller and larger ones. Prepare an estimate for each of the three buildings to determine the total cost of each and plat the total costs in a graph using the total volumes of the buildings as the abscissas and the total costs as the ordinates. Through these three points pass a flat curve. This curve is the "total cost curve." The "unit cost curve" is developed from the "total cost curve" by selecting various volumes and their respective total costs from the "total cost curve" and reducing each to a cost per cubic foot of volume; these values are then platted by using the volumes as ordinates and the costs per cubic foot of volume as abscissas. A smooth curve passed through these points is the "unit cost curve" for this type of building, for any volume within the limits of the curve. Some engineers have endeavored to develop the "unit cost curve" on the assumption that the curve is a parabolic curve, but its equation is not the equation of a parabola.

A study of shop buildings and various other classes of railroad buildings indicates that within each classification, the buildings increase materially in length as the volume increases, but the variation in width and height is small. Due to the variation in width and height, it is impossible to derive an equation that is theoretically correct unless it takes into account the three factors of length, width and height with constants and variables for each. An equation, however, can be derived for a curve which for all practical purposes will represent an average "unit cost curve" for buildings.

To develop the equation of the cost curve, consider for example, the following two frame buildings used as passenger stations; their general type of construction being similar:

	Width, Ft.	Length, Ft.	Height, Ft.	Vol. Cu.Ft.	Est. Cost	Unit Cost
Building A	20	60	17.5	21,478	$2,302 30	10 7c
Building B	14	28	14.5	5,860	1,443 41	24 6c

The volume of building A is 3.664 times as large as that of building B. If the widths and heights of these two buildings were identical the length of A would consequently be 3.664 times the length of B. If this were true and all the materials in building A were increased in proportion to the volumes of A, and B, then building A would replace building B in its entirety 3.664 times. This would increase the cost in the same proportion and consequently the unit cost of A would be the same as that of B. The total cost of A under these conditions would be $5,283.59, an increase of $2,981.29 more than the actual estimated cost. In constructing A, although the volume is more than triple that of B, certain units remain constant in both buildings, as for example the ends, bay window, chimney and various minor items. These items then, in this particular example were included but once in the construction of building A and therefore omitted 2.664 times. The cost of these omitted items is $2,981.29 as developed above which if reduced to one unit, gives a total cost for the two ends, bay window, chimney and other constant items of $1,119.10, which is the "constant total cost of constant units." Deducting the "constant total cost of constant units" from the total estimated cost of building B and dividing the remainder by the volume of the building we have the "constant unit cost of variable units." The following equation is then self-evident using symbols as designated.

Let x = total unit cost; y = total volume; K = constant total cost of constant units; a = constant unit cost of variable units; C = total cost of building.

Then
$$C = ay + K \qquad (1)$$

and
$$x = a + \frac{K}{y} \qquad (2)$$

Equation (1) is the equation of the "total cost curve" if the widths and heights of the buildings are constant, but since there is a variation in these dimensions the

equation of the "total cost curve" is theoretically, of the general form $C = ay^n + K$. (3)

This is explained by the fact that the cost of a building approaches a minimum as the building approaches the shape of a cube. Therefore as widths and heights slightly vary, the power of y in the equation will vary. If the widths and heights practically remain constant for all buildings in a type, y^n in equation (3) will approach y and the equation of the "total cost curve" will take the form of equation (1) which is the equation of a straight line. Taking into account the variation in the width and height, the "total cost curve" is a flat circular curve instead of a straight line.

If the "total cost curve" is developed graphically by passing a flat curve through three platted points representing total estimated costs of three buildings and a "unit cost curve" is developed therefrom, this curve will nearly coincide with one developed from equation (2). Theoretically the "unit cost curve" graphically developed from the "total cost curve" will give more nearly correct results than the equation, and the use of the graphical method is therefore recommended.

Example of Development—Assume the determination of a "building unit cost curve" for frame passenger stations of volumes from 500 cu. ft. to 9,000 cu. ft. The following buildings are selected as typical:

	Dimensions: Width, Ft.	Height, Ft.	Length, Ft.	Volume, Cu.Ft.	Total Cost	Unit Cost
(A)	10.3	x 10.25	x 12	1,267	$284.89	0.225
(B)	12.0	x 11.75	x 16	2,264	351.04	0.1563
(C)	16.0	x 14.0	x 22	4,928	533.07	0.1082

$$\frac{\text{Vol. (C) 4,928 cu.ft.}}{\text{Vol. (A) 1,267 cu.ft.}} = 3{,}889;\ \text{the ratio of volumes}$$

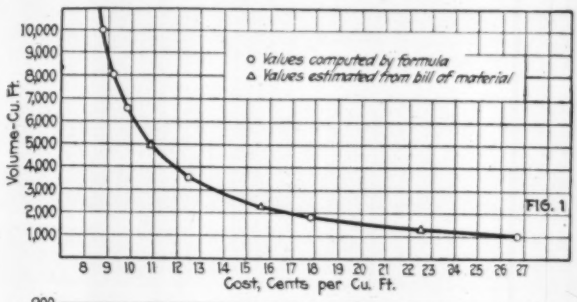
Had it been necessary to reproduce all materials in building (A) 3.889 times in order to construct building (C) because of the volume of building (C) being 3.889 times as large as building (A), the unit costs would have been the same and the total cost of building (C) would have been 4,928 cu.ft. x 0.225 = $1,108.80, the total multiple cost, using unit cost of building (A). Deducting $533.07, the total actual cost using unit cost of building (C), we have $575.73 as the estimated cost of constant units not required in building (C). Dividing $575.73 by 2.889, we get $199.28, the constant total cost of constant units designated as K. Deducting from $284.89 the total cost of building (A), $199.28, the constant total cost of constant units, we have $85.61, the constant total cost of variable units. Now, $85.61 ÷ 1.267 = $0.0675 constant unit cost of variable units which has been designated as a.

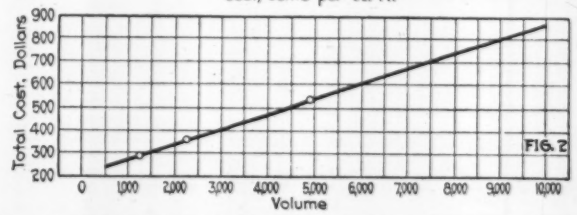
Substituting these values for K and a in the equation $x = a + \frac{K}{y}$ and the values for y as indicated in the following tabulation, the corresponding values for x are derived.

Volume y	Unit Cost
1,000	0.2668
1,800	0.1782
3,500	0.1245
6,500	0.0982
8,000	0.0924
10,000	0.0874

The above values for x and y and the values developed from the estimates for the three buildings used as examples are platted in Fig. 1 and a smooth curve passed through the points. This curve is the "unit cost curve" for any size building similar in construction to the three selected.

Fig. 2 represents the "total cost curve" developed by passing a smooth flat curve through the three points platted and relatively representing the three typical buildings. Fig. 3 represents a "unit cost curve" developed graphically from the "total cost curve," Fig. 2,





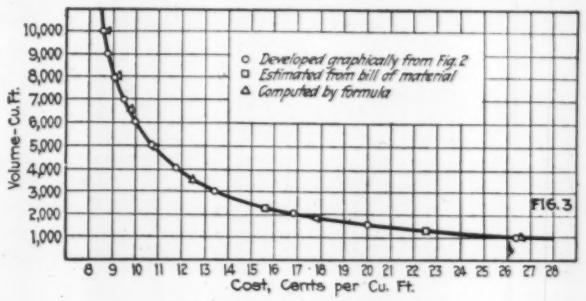

o Developed graphically from Fig. 2
□ Estimated from bill of material
Δ Computed by formula
Volume-Cu.Ft.
Cost, Cents per Cu. Ft.
FIG. 3

FIG. 1—UNIT COST CURVE

This curve, derived from the estimated costs shown by the points in the triangles, indicates the relation between cubical contents and cost per cubic foot.

FIG. 2—TOTAL COST CURVE

A smooth curve passed through the total costs of three typical buildings of different volumes.

FIG. 3—COMPARISON OF UNIT COST CURVES

Relation between estimated unit costs derived graphically from Fig. 2 and computed as in Fig. 1.

by assuming various volumes and computing the respective units cost from the "total cost curve." The points indicated within a triangle represent values derived by using equation (2). It will be noted, that for large volumes the difference in cost between the graphical method and the analytical method is approximately one tenth of a cent per cubic foot or about one per cent; for volumes near the center of the curve, the unit costs developed by both methods are identical and for the small volumes there is a difference of two tenths of a cent per cubic foot or less than one per cent.

The foregoing comparison bears out the discussion that "unit cost curves" developed by both methods are practically identical and for all practical purposes, equation (2) is the equation of the "unit cost curve."

Topographic Surveys in 1922

During the fiscal year ended June 30, 1922, the topographic branch of the U. S. Geological Survey surveyed more than 12,000 square miles of new area, exclusive of Alaska, and resurveyed approximately 1,500 square miles.

Experience with Metal Forms for a Flat-Slab Floor

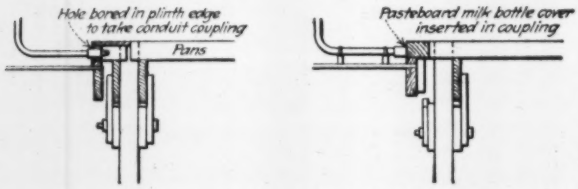
System for Using Old Metal Forms Worked Out on Job and Saves Money, But Wood Forms Advocated for Most Jobs

By Dan Patch

Aberthaw Construction Co., Boston, Mass.

In the matter of total cost and of safety and convenience in construction, the use of wood forms for flat slab construction would seem at the present to have in its favor a considerable margin over metal forms. The experience of the writer's company during the past summer in the use of metal forms, would lead, however, to the conclusion that the margin might eventually be made much narrower.

One of the disadvantages of standardization of design and method is the difficulty which arises when an organization, trained to the minute on its own kind of work, hits something new. The very momentum of standardization may then become a handicap. The company the writer works with is proficient in typical flat slab form construction. It has just been carrying through a contract, however, for an owner who had on the site, rented for a previous operation, a full equipment of steel pan forms, and a partial equipment of supporting members. From the time the erection of this system of forms started the field reports showed costs so far above those of standards that it was evident that something must be done if estimates were to be



METHOD OF SETTING SOME CONDUIT BENDS

met, even with the rent free use of the metal pans. An investigator was accordingly sent from the home office to the job to study the operations.

Details of Metal Forms—The pans used were 3 in. in depth flanged inward at the edges with stiffening pieces running crosswise. The main pans were in three sizes, 18 in. x 4 ft., 2 x 4 ft. and 2 x 6 ft. The smaller reshore pans were 1 x 4 ft. and 1 x 6 ft. with end flanges omitted so that posts under their ends could bear them securely against the slab, while the main pans were supported on the flanged edges by joists set on shoulders bolted to the posts. These shoulders were tapered to a standard taper and hard wood wedges of the same thickness and taper were inserted under the joists and used for adjusting the joists into the proper relation to the post tops.

The joists and wedges were kept in place laterally by 2 x 4 in. arms which pivoted on the shoulder bolts and could be swung down for purposes of stripping. The two 2-in. joists plus the 4-in. post made an out to out of 8 in. which had the design been made to fit the pans, would have given ample landing for the pan edges. As it was, the plinth sizes were such that a post spacing was necessitated which gave only the 2 in. joist width as a landing for certain rows of pans.

Routine of Erection—The operations as observed by the investigator were as follows: Set up and brace plinth towers, set and center plinth tops, mark off post lines on paving or slab below, set up posts with pair of wedges under each and brace with ledger boards, put up joists, throw up arms and place hard wood wedges on shoulders, lay pans on joists, saw off post tops which interfere with pan flanges, grade up from under floor, arrange pans, final grade from top of pans, drive up loose and nail all shoulder wedges, fit wood filling pieces and panels, scrape and oil pans.

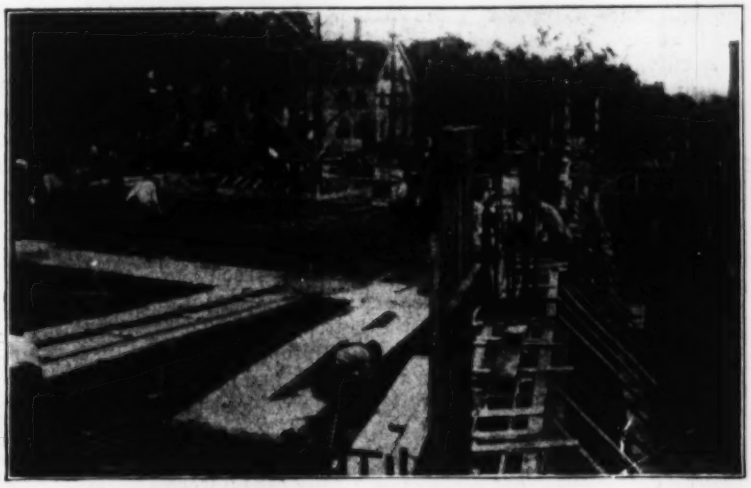
Time studies were made to determine what proportion each operation was of the total and to indicate where the greatest possible field for cost reducing study might lie. Some of the difficulties encountered and methods of eliminating will be enumerated.

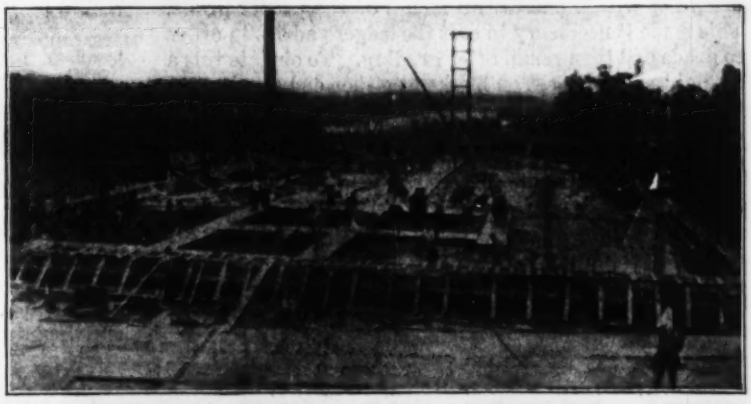
It was found that one of the costly operations was the wood filling in, necessary because the building had not been designed in multiples of pan dimensions. This would seem to be an argument for the closest kind of co-operation between designing engineers and construction companies and the very probable reason for lower cost buildings by construction companies who build to designs made by their own engineering departments. These filling in pieces and panels were seen to be unsymmetrical, this symmetry being also responsible for the use of extra posts and joists near certain of the plinths.

The investigator accordingly laid out a complete form assembly to a scale of ½ in. = 1 ft. with a color key to show supporting structure, pan landings and filling. The same assembly carried the design of the wall beam bottoms and supporting jacks to suit the floor pans. It is always better to eliminate unnecessary operations before making any attempt to speed up work. This assembly not only eliminated many moves on the part of the carpenters and move men, but saved a considerable amount of lumber. The carpenters had been putting in place two 2 x 8 in. joists at each side of the plinths. The one of these adjacent to the plinth had no pan landing on it and bore only a filling piece which made the plinth edge. In the assembly drawn up by the investigator the joists adjacent to the plinth were omitted and four cleats were nailed to the plinth top frame, which was stripped and moved with these tops, to bear the plinth fillers. This saved a considerable amount of labor and lumber.

The operation of sawing post tops was seen to be unnecessary after the first set up if the locations of the short tops could be marked on the plan and distinguishing bands marked on the posts for these locations. There was a slight variation in the length of joists for certain locations. Carpenters invariably had to measure up or try and reject. A complete marking scheme was developed and the move men taught the location of each piece by mark. This allowed carpenters to do real work instead of sorting and saved the inevitable waste due to carpenters cutting the longer timbers rather than locate the shorter ones.

Some Improved Methods—As mentioned previously, certain of the rows of pans could, on account of the design, have only the 2-in. joist width as a landing and as there was no method of tying the pans to give continuous strength, it was quite easy, when working from the bottom up, to have joists now and then out of line enough so that the pans when laid and lined up would find no support whatever for one of their ends. This necessitated either casting off the ledgers and re-





ERECTING METAL PAN FORMS FOR A FLAT-SLAB CONCRETE FLOOR

Upper, left—Carrying column heads to be set. Lower, left—Erecting the plinths to support the pans. Upper, right—Wall beams at right. Middle, right—Floor about ready to concrete. Lower, right—Erecting the main joists.

aligning the posts and joists or the spiking on of 2 x 4 in. continuous cleats to the joists. To eliminate this correctional work which cost considerable and to assure symmetrical filling pieces at plinths, spacing battens were made and all posts were set up with the tops correctly spaced. With a high story height, even if set up with a spirit level the posts set to a bottom spacing will be out of line at the top. The spread of the plinth tower posts was just enough different from the adjacent lines of centering posts, so that it was difficult to run the ledger boards in a continuous line across the building. The spread was changed and the difficulty was eliminated.

As the forms were being erected when the investigator went to the job the filling pieces at the plinths were so wide that timbers boarded over were used. With the new layout it was possible to use a single 3 x 4 in. piece at each plinth edge across the building except the two middle edges, where filling pieces were eliminated entirely by using two 4-ft. pans instead of one 6-ft. pan for the middle bay. In order to use the 3 x 4 in. solid filler a change was made in the method of setting some

conduit bends as shown in the drawing. This change made easier stripping and re-use of filling pieces.

Saving Time and Money—The time studies had shown that there was much time lost due to bringing pans onto the floor before the supporting structure was ready ahead of them. By keeping the pans off the working floor until a place was ready to lay them, a second handling was saved.

The operation of grading the floor had appeared to be one of excessive cost. This was partly due to the fact that there were two points of adjustment between the floor below and the pans above, one between the joist and shoulder and one between the bottom of the post and the floor. The cost was reduced by proper adjustment of joist tops and post tops at the start, and nailing in the wedges. Grading cost was further reduced late in the job by a scheme of one of the job engineers which was undoubtedly of value and should become one of the regular operations. The posts as originally set up were often not within one to two inches of the proper grade. This made it necessary to cast the ledgers adrift in order to grade and then renail after grading. To obviate this a straight edge was set on blocks at either end so adjusted that when they rested on the plinth panels the straight edge was at the grade of the post tops. This allowed the posts to be set so closely to grade before the ledgers were first nailed that the final grading could be done without detaching them.

That the study made of this job had a distinct financial value would be indicated by the following cost figures. About 15 per cent of the job had been done when the study methods were adopted.

	Average Cost per Square				
	First 15 Per Cent	Last 85 Per Cent	Difference 85 Per Cent	Quantity 85 Per Cent	Labor Saving
Floor slab.....	12.84	7.81	5.03	1098	$5,530
Wall beams....	26.19	19.39	6.80	148	1,006
					$6,536

No estimate has been made of the material saved. There was an additional labor saving on the wall beams due to a change in squad bosses which amounted to $273.

Costs—The costs per square for the last week's work were $6.70 and $15.35 respectively, which would lead the writer to believe that the investigator may not have squeezed all the water out, and that the average of $7.81 might be lowered on another job. From such information as has come through to him, however, he would venture the following conclusions:

1. That for New England, at least, wood panels still give a more economical system of forms for concrete construction. The steel pans save very little lumber in the supporting system and the labor saved due to not having to make up panels is partly lost by the labor necessary to mill and assemble the special posts with shoulders and arms.

2. In hot weather the steel pan floor is more difficult for the men to work on.

3. Lack of continuity and difficulty of tying in wall beams, floor stops and other members makes steel pans less attractive.

4. Inserts, "Hy chairs," and sleeves are more difficult to set on steel pans.

5. While steel pans may outlast wood panels, after a few uses much labor has to be expended on them in order to get good concrete surfaces.

6. This type of steel pans, after any considerable use, give the ceiling a wavy appearance due to deflection between flanges and ribs.

City Zoning Adopted by 110 Cities

TO THE close of 1922 zoning had been adopted by 110 municipalities in the United States. Additions to the table published in *Engineering News-Record*, Sept. 28, 1922, p. 519, in the article by Mary T. Voorhees, of the Division of Building and Housing, United States Department of Commerce, to bring the record to the close of 1922, are as follows, according to Miss Voorhees:

ADDITIONS TO ZONING ORDINANCE CITIES

"Comp." indicates comprehensive. "Use" means use district only. The last column gives the dates of adoption.

CALIFORNIA				Hillside.....	Comp.	1922
Fresno.....	Use	....		Kearney.....	Comp.	1922
So. Pasadena.....	Comp.	1922		Madison.....	Comp.	1922
ILLINOIS				Orange.....	Comp.	1922
Berwyn.....	.....	....		Passaic.....	Comp.	1922
Highland Park....	.....	....		West Hoboken....	Comp.	1922
Maywood.....	.....	....		NEW YORK		
Riverside.....				Binghamton.....	Comp.	1922
Wilmette.....	Comp.	1922		Brightwaters.....	Comp.	1922
INDIANA				Buffalo.....	Use	1922
Indianapolis.....	Comp.	1922		Endicott.....	Comp.	1922
MASSACHUSETTS				Jamestown.....		
Lowell.....	Use	1922		Mount Vernon.....	Comp.	1922
Newton.....	Comp.	1922		OHIO		
Springfield.....	Use	1921		Bay Village.....	Comp.	1922
MINNESOTA				Euclid Village.....	Comp.	1922
Minneapolis.....	Height	1920		Grandview Heights	Comp.	1922
NEW JERSEY				Idlewood.....	Comp.	1922
Cranford.....	Comp	1922		Mansfield.....	Use	1920
Elizabeth.....	Comp.	1922		TENNESSEE		
Fort Lee.....	Comp.	1921		Memphis.....	Comp.	1922

About 40 per cent of the 110 cities adopted zoning in 1922. Of the 110, 74 have complete zoning, including use, height, and area restrictions; 27 regulate use only; 1 each regulate use and height, use and area and height alone, and further extent of the regulation is not reported. In the original table, Newark, N. J., should have been listed as having adopted zoning in 1919 instead of 1920, the ordinance having been passed late in December, effective Jan. 3, 1920.

Four Missouri River Crossings to Be Built by Missouri State

Hitherto only three highway bridges have crossed the Missouri River within the State of Missouri: at Kansas City, Jefferson City, and St. Charles, all of them toll bridges. They are far too widely separated for the needed interconnection of the highway systems on the two sides of the river. Accordingly, four new crossings are being built by the state highway commission, under Federal Aid. They are located at Boonville, Glasgow, Waverly, and Lexington. All are high-level bridges, requiring no movable spans. The Boonville bridge will have 2,665 ft. of steel bridge, 447 ft. of reinforced-concrete trestle, earth-fill approaches and a roadway 18 ft. 8 in. wide and will cost $527,000. The Glasgow bridge, with four river spans, totaling 1,224 ft. and 684 ft. of approach spans, will have a roadway width of 21 ft. and will cost $566,000. The Waverly bridge, with five river spans aggregating 1,610 ft. and 345 ft. of approach spans, will have a 20-ft. roadway and will cost $585,000. The Lexington bridge, largest of the group and with the greatest depth to rock (100 ft.) will have a 20-ft. roadway, will cost $1,169,000, and will comprise 3,071 ft. of steel superstructure. J. A. L. Waddell is consulting engineer for the Lexington bridge, F. W. Adgate for the Glasgow, and Harrington, Howard & Ash for the other two. Their construction is under the direction of B. H. Piepmeier, chief engineer of the state highway commission.

The Present Status of Sewage Treatment in England—III

Impressions Based on Visits to Various Works and on Interviews with British Specialists in January, 1923, Presented with a View to Current American Problems

By George W. Fuller
Consulting Engineer, New York City

From his observations at eight British installations, Mr. Fuller concludes that the activated-sludge process has come to stay, although much is yet to be learned regarding it. Preliminary treatment in England exceeds that in the United States. As a rule, nitrification is not being sought or obtained. The present competition between air diffusion and mechanical agitation is described and the patent situation outlined. As a rule, disposal of the excess sludge has not yet been faced as a separate problem, since the sludge usually goes in with other sludge for disposal. Activated-sludge installation costs seem to be lower at some works than revamping old works of other types. Operating costs range from £2 to £2 10s. per million imperial gallons for 1-m.g.d. installations with power cost 7d. per kw.-hr., an average of $9 per million United States with current at 1.4c. per kw.-hr. The two earlier articles appeared Feb. 1 and 8, pp. 206 and 252.—Editor.

Outlook for the Activated-Sludge Process

ON ENGLISH evidence alone this method has come to stay, with a certainty that more and better data concerning it will be available year after year. I saw eight installations, built or building, for its use on a sizeable scale, although in each instance only a part of the total sewage flow was treated. While these may be termed demonstration plants, yet it is worthy of note that the Ministry of Health has sanctioned a loan for building works for treating by this method the entire sewage flow of Reading, from plans of Midgely Taylor, one of the foremost sanitary engineers. Further, designs are being prepared by Haworth for the entire flow at Stockport. Caink at Worcester is similarly engaged on units for treating all local sewage. Sizable plants are under way or projected at Sheffield, Hanley, Birmingham and in the Bury district. Numerous investigations on a small scale are being conducted, particularly at London and Bradford.

Soundness of Method—The scientific basis on which this biological process is founded is undoubtedly sound, regardless of the limitations which its practical application may encounter. It stands up against trade wastes surprisingly well. I heard of only two instances where difficulties had been noted: gas-house wastes or tar at Manchester and an inhibiting effect on bacteria reported by the chemist at Leeds as caused by local trade wastes at times. I was interested to note that Garfield finds that by applying in a 30,000-gal. tank about 3 cu.ft. of air per gallon for an average period of 40 to 48 hours he can activate the Bradford sewage so that grease is removed by oxidation at the rate of about two tons per million gallons. (Unless otherwise stated tons of 2,240 lb. and imperial gallons are used throughout this article.) This intense selective action of the bacteria causes the temperature of the sewage to rise from about 60 to 80 deg. F. and converts the sewage into quite an effective coagulant.

Status of the Art—There is a vast difference between theory and practice concerning this method. No matter how sound the scientific basis, its usefulness depends on the skill shown in the art of its application. Basic data obtained on a sizable scale are now coming steadily forward, but it will be a long time before we know as much about this method as we do about some other lines of engineering, where practice has become stabilized, if not standardized. On the other hand, there is no reason why this method cannot be adopted, if desired, at most localities provided the margins of capacity are not made too small or provided there is not a disposition to look too closely into costs, either actual or relative. A leading question, ordinarily, will be a decision between this method and sprinkler beds, and for this the answer will no doubt vary in accordance with a number of local factors. Perhaps this question may be settled now at some localities without much investigation; but I doubt it, as a general proposition.

Preliminary Treatment—Before aeration the English sewages are clarified to a much greater extent than in America. The detritus tanks at Tunstall hold 1/100 d.w.f.; at Manchester from 40 to 60 minutes flow; and at Bury and Birmingham the aerated sewage has first been thoroughly sedimented. At Worcester a flow of about 750,000 gal. daily is pumped at the end of a tunnel from a suction well 20 ft. in diameter and 84 ft. deep, with the suction pipes extending about midway into the sewage, the depth of which ranges from 50 to 60 ft. Ardern favors tanks holding 1½ hours for dry-weather flow, which gives ½ hour at 3 × d.w.f. Haworth at Sheffield has used tanks holding about one hour's dry-weather flow, but for Stockport where the sewage contains much trade waste, he will have tanks holding 15 hours' dry-weather flow, and five hours' of wet-weather flow. Makepeace is providing at Hanley detritus tanks holding two hours' dry-weather flow. Thus it is seen that the clarified English sewage more nearly compares with American sewages before aeration than one might suppose.

Nitrification—At none of the plants visited was nitrification of the effluent sought or obtained, except at Tunstall, although the Worcester data are not at hand at the moment. This is attributed to the influence of trade wastes, as nitrification is said to appear during holidays. The settled effluent is clear and stable. Nonputrescibility seems to be due partly to oxygenation but principally to the successful removal of colloidal organic matter. I surmise that the separation of colloids from the more concentrated English sewages may come about rather more readily than in the case of the weaker American sewages. Perhaps the influence of iron salts is a greater factor than generally realized. However, the coagulating capacity of the returned activated sludge seems in some cases to be more of a factor than is generally regarded as the case in America.

Comparison of Data—American engineers have been somewhat puzzled to know why with the air diffusion plants there has been used in England for concentrated sewages rather less air per volume of sewage than with the weaker American sewages. Without discussing details, mention may be made of several elements.

1. English sewages are better clarified.

2. American plants are operated to produce more nitrification, partly with the view to getting sludge which more completely contains the colloids and partly in the hopes of promoting ease of dewatering.

3. Metal salts are seemingly more of a factor in England.

4. The sewages at Milwaukee and Houston are not particularly weak from the English viewpoint, and the test plant at Cleveland, with a weak sewage containing iron, showed quite good results with perhaps one-half of the quantity of air ordinarily used in America.

Differences in methods of analyses make it difficult to compare laboratory data in very precise terms. The influence of concentration upon the ease of separation of colloids needs elucidation. At some American plants there is quite likely a waste of air in preventing deposition in the aerating tank of solids from the less clarified and less comminuted American sewages. With such depositions come deaeration and the need of overcoming its effect on the main body of sewage aerated.

Competitive Arrangements—There is more or less competition between "air diffusion" and "mechanical circulation" arrangements. Of the latter there are two types, one developed by Bolton at Bury and the other by Haworth at Sheffield. The Bolton device provides surface agitation and aeration in a tank by revolving buckets on an agitating cone or apron attached to a shaft, with the buckets fed by an uptake pipe leading sewage from the bottom of the tank, which has a hopper bottom. The discharges from the buckets splash the surface with resulting waves and a circulatory movement of the entire contents of the tank. At Sheffield, Haworth uses paddle wheels to produce surface aeration and circulation of the contents of a series of channels about ¾ mile in extent at a velocity of about 1.5 ft. per second. These respective details are well described in recent issues of the London *Surveyor*. The diffusion plates and other associated arrangements are subject to patents secured by Jones and Attwood who did a good deal in earlier years to develop the art of applying this process and who recently assigned their patents to Activated Sludge, Limited, 14 Howick Place, Victoria St., London, S. W. I. The Bury device has been patented by Bolton and its selling agents are Ames Crosta Sanitary Engineering Co., Ltd., 12 Victoria St., Nottingham. The Sheffield arrangements have not been patented by Haworth who is serving as consulting engineer for several English cities and also for the Sewage Disposal Division of the National Department of Public Works in Holland. There is considerable competition between these different arrangements, with more or less discussion and controversy over their respective merits. In fact, I am reminded of the more or less similar discussions which I noted during a visit to England in 1900 as between contact beds and percolating filters.

It is said that about 30 brake horsepower is continuously required to provide aeration for treating 1 m.g.d., by either air diffusion or the Sheffield paddle wheels, while about one-half this power is sufficient for the Bury device. Some of the mechanical appliances are crude, as is usually the case with early beginnings, while others seem to be on a fair working basis. The difficulty in comparing these arrangements does not seem to me to relate so much to estimating the power required to actuate certain devices as it does to equating work done in treating different sewages for different periods in tanks of different types. Directly comparable data on a working scale are not available. I understand that Watson has made comparative tests on a small scale at Minworth and that he will soon begin an installation on a large scale. At London tests were carried out last year at Crossness with air diffusers and beginning in January of this year tests are understood also to include each type of mechanical circulation.

Combined Aeration and Sedimentation Tank—The only tank of this type was found at Bury. It is not believed to serve well the fluctuating flows in cases where the entire city sewage is treated, rather than at a fairly uniform flow as in test devices. Bolton is not using it in his new design for the neighboring town of Prestolee. More sedimentation seems desirable.

Flexibility of Arrangements—There is a good deal of difference between test devices and those needed in actual operating practice. In this respect I believe the English engineers are studying their designs most carefully in order to have the large plants meet the practical needs which vary so much from time to time. It is apparent that margins of capacity are being greatly increased and that devices are being studied to give as much flexibility of performance as is practicable.

Size of Aerating Tanks—The capacity of the aerating tanks in terms of dry-weather flow is about 8 hours at Manchester; 12 hours for the new Hanley works designed by Makepeace and for the Prestolee project being designed by Bolton; 15 to 18 hours at Sheffield; and 18 to 24 hours for the new works being designed for Stockport by Haworth. Watson will use 1 hour for the influent to his Minworth filters. The above sizes are generally larger than formerly were needed, but it is the intent of several of the designers to put through 3 × d.w.f. during storms. In this respect greater flexibility is claimed for the activated-sludge method than for sprinkler beds. But this does not mean much without detailed comparative study of loadings and costs.

Details of Aerating Tanks—Caink has operated a 750,000-gal. plant for seven years, during which time I understand that he has taken out and repaired 52 of the 350 diffuser plates. The cost of this per million gallons cannot be great but it suggests perhaps the desirability of standby tanks, should several tanks need repair at once, although I understand the clogging ordinarily comes on gradually. "Rusting" of the plates does not seem to be a serious factor (as at Houston) although the plates are set in cast-iron frames and fed by galvanized-iron drop pipes. Plate clogging has been noted at Manchester and Tunstall but is said not to be serious. New designs at the Withington sewage-works at Manchester and at Hanley provide one longitudinal row of plates in each bay. The ratio of plate to floor area at Hanley is 1:16, as is also true at the second Withington plant now being built as a duplicate of the Davyhulme plant which went in service in March, 1921. At both of these Manchester plants the line of diffusers is at one side of the flat floor of the bay, while at Hanley the diffusers are in the center from which the floor

slopes upward on either side. The circulatory movement of the sewage and sludge seems to be effective in providing a bottom velocity of about 1.5 ft. per second and in preventing bottom deposits. The saw-tooth floors with diffuser plates placed transversely in the bays seem to be abandoned in new designs. At the Hanley works the bays are subdivided by several double transverse walls, of which the first extends from the bottom to the established flow line and over which the sewage passes, meeting the second wall which extends from above the flow line nearly to the tank bottom.

Volume of Sludge—I judge that the volume of sludge in the aerating tanks, after settling 1 hour, would range from 15 to 25 per cent at several of the plants. But I was interested to note two exceptions, one above and one below the "normal." Watson has used, I understand, at his filter influent plant only 5 to 15 per cent of solids by volume in his aerating tanks. On the other hand, Makepeace has used at Tunstall a volume of solids reaching as high as 60 per cent after settling three hours. This reduces the apparent period of aeration in the tank but he is inclined to think that it explains why he gets so good nitrification and helps in handling more flow at times of storms than would otherwise be the case. His present program is to return all sludge to the inlet of his aerating tanks and about once a week send the excess to the detritus tank.

Air Used—I found that at Worcester and Tunstall the air amounted to about 1 cu.ft. per Imperial gallon [0.833 cu.ft. per U. S. gal.], while at both Manchester works the average figures were given as about 1.4 cu.ft. Compressors are usually operated at about normal capacity and the quantity of air is really a function of varying rates of sewage flow through the aerating tanks. Thus at Davyhulme I found the registers to indicate only a little over 0.5 cu.ft. per gallon, due to a high rate of sewage flow at 11:30 in the morning.

Humus Tanks—Tanks of the Dortmund type are used with the intent of getting a sedimentation period of about two hours, at maximum rate, and a velocity of not over 8 ft. per hour. In terms of dry-weather flow the capacities are usually four to six hours, depending on whether the wet-weather flow will be 2 or 3 × d.w.f. A one-hour period at Worcester proves too small.

Sludge Handling—The excess sludge at most English plants of the activated-sludge type is mixed with other sludge produced at the works, and so the issue per se has been faced in only a limited way. Makepeace considers that he has a reasonable solution of the problem by pressing a mixture of the activated sludge and of plain sedimentation sludge obtained by the use of relatively large detritus tanks. At least that is his actual program at Tunstall and his projected program for Hanley. Pumping liquid sludge onto cultivated land within a radius of a few miles was mentioned by several, in order to make use of its fertilizing properties. The latter are quite favorably reported on from the Rothamsted Experimental Station, where tests have recently been made with expenses met by the Ministry of Agriculture. For two years Haworth has applied the activated sludge coming from the Sheffield plant dealing with the sewage of about 20,000 persons, and containing about 99 per cent water, on about two acres of land of a texture only moderately porous. The secret of success seems to be to give the surface a slope of perhaps 0.5 per cent, so that the clear water can run ahead of the solids which close the voids of the surface. The area has been spaded with care. Several have mentioned this method as quite satisfactory if the area equals 4 sq.ft. per person served. Caink has also applied the sludge from the Worcester plant to an area of about 2.5 acres for about 20,000 persons. I visited this plant after a long period of heavy rains and found that it was generally covered with sludge, of which only a small portion was spadable. This area seemed more porous than that at Sheffield but it has been much longer in use, and it will shortly be much enlarged. Caink says he has had no complaints from odors. He regards it more as a lagooning than a sludge drying area. However, he gets the sludge to a 70-80 per cent water content, permitting him to sell it for 10s. per ton at the works, or 20s. if he delivers it to the railroad station. At Manchester, Sheffield and some other places studies have been made on dewatering the sludge by vacuum filters and dryers, but I doubt if available English data approach in extent those obtained at Milwaukee, Chicago and Houston. The English have done enough to realize the difficulty of dewatering activated sludge which may behave quite differently depending upon varying composition both chemically and biologically.

Efficiency and Cost—There is no doubt about the capability of this process to turn out a stable, clear effluent, without air nuisances in the neighborhood. Its installation cost is attractive to the English as it is less, apparently, at some places than that of revamping existing works. Operating costs vary. They are stated as ranging at some places from £2 to £2 10s. per million gallons for a 1,000,000-gal. installation with power costing 7d. per kilowatt-hour.

Patent Situation—It appears that Jones & Attwood and their successors, Activated Sludge, Limited, have spent considerable money for the development of this process, including the early construction of several plants, such as the one at Worcester, under guarantee as to performance. Steps for recouping early losses and the continuing upkeep of offices with a technical staff at Westminster are not easy to negotiate, no matter how equitable they are. To add such overhead items to factory costs, as is done by the makers of pumps, boilers and other lines of equipment in extensive use, probably has it drawbacks because of the relatively small sums of money involved in these particular products. Furthermore, the owners of patents associated with the air diffusion devices and method now face competition from two types of mechanical circulation appliances, of which one is patented and the other not. Such a situation stimulates interest and discussion but over-promotion easily leads to exploitation which is usually disastrous to all concerned. Competition within reasonable limits is helpful and I doubt if experienced engineers begrudge reasonable overhead expenses to promoters and sellers of patented arrangements. The program as to the status of patents on the activated-sludge method does not seem to have become fully matured, and development will be watched with keen interest. This is particularly true of American engineers who have followed during the past twenty-five years the course of such patented arrangements as the Cameron septic tank, the Imhoff tank, the mechanical or rapid sand water filters, to say nothing of more recent proprietary devices for sewage treatment.

Force-Account Bridge Building in South Dakota

State Highway Department Crews Build Wood and Steel Spans—Wood Truss Design—Solid Plank Floor for Old Spans

HIGHWAY BRIDGE construction on a force-account system by the state highway commission has become necessary in South Dakota in several cases where the work was in undeveloped country and remote from railroad communication and therefore failed to interest contractors, especially when plenty of more attractive work was available elsewhere. As organized by J. E. Kirkham, bridge engineer of the commission, the bridge department has had a field force consisting of one to three crews, each crew consisting of five to ten men under a foreman. Mr. Kirkham looked after the training of these crews and supervised the work, assisted during a part of the time by two construction engineers. These crews have built steel and timber truss spans and concrete viaducts and culverts.

Cheyenne River Timber Truss Bridge—Reconstruction of the 640-ft. bridge over the Cheyenne River near Hot Springs in 1921 was an emergency force-account measure necessitated by the washing away of the old steel structure. A new steel bridge would have cost about $85,000, but no such amount was available for the purpose. A wooden bridge with five Howe truss spans of 70 to 94 ft. in length, built of native Black Hills pine, was designed by Mr. Kirkham and erected by his department at a cost of about $16,000, including 250 ft. of pile trestle. This bridge, which is shown in Fig. 1, is designed to carry a 10-ton tractor. It is estimated to last about fifteen years. The stress allowed on the timber was 1,000 lb. per square inch in tension and $1000 - 20l/d$ in compression, where l equals the length of the member in inches and d the least diameter in inches. In order to avoid danger from floods, the height of the old stone piers was increased by timber cribs to put the spans 4 ft. above high water.

Special features in the truss design of this bridge, Fig. 2, are the double floor beams and the oak bearing blocks instead of castings to support the ends of the web members. The oak blocks were used to save time and expense and are expected to last the full life of the

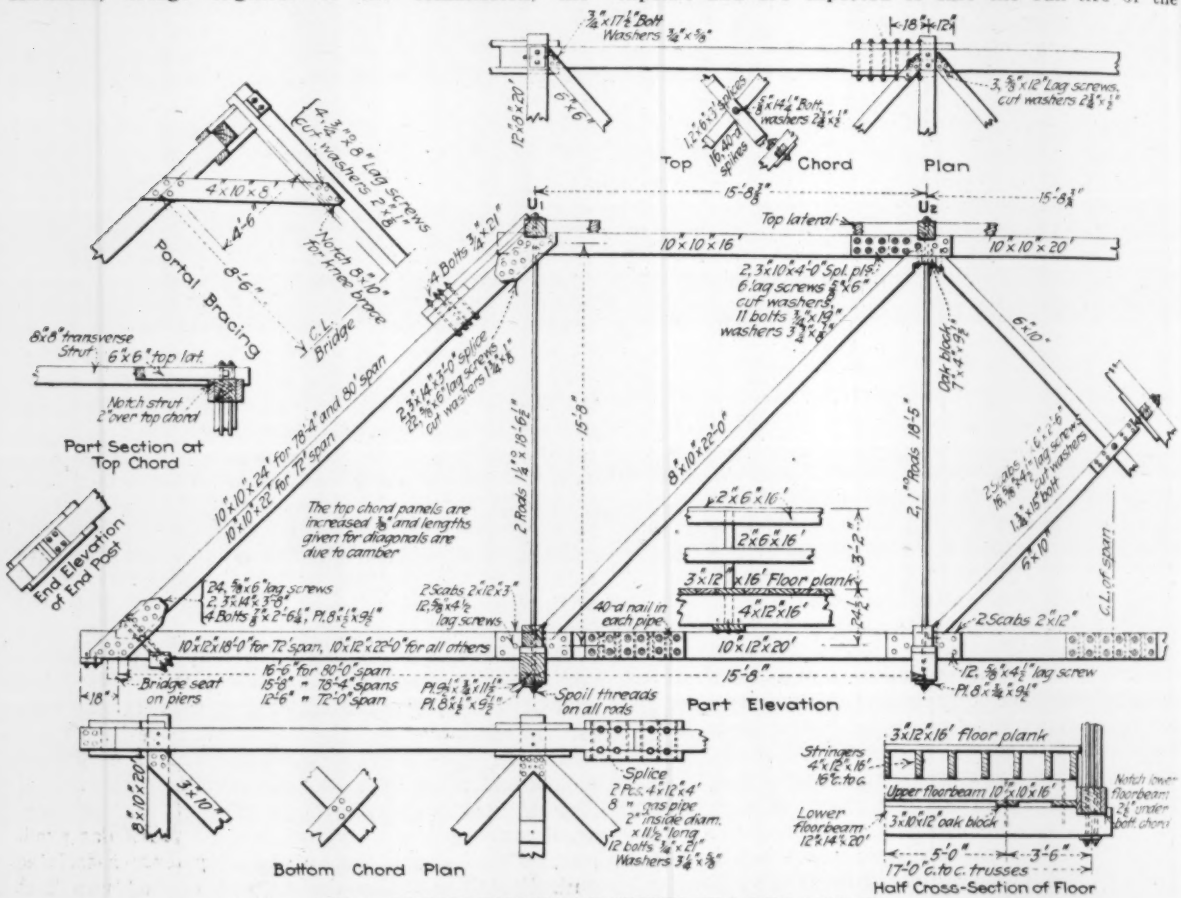


FIG. 1—TIMBER TRUSSES OF CHEYENNE RIVER BRIDGE

bridge. Single timbers of the size required for floorbeams were not obtainable, the largest sticks being 12 x 14 in. Each floorbeam, therefore, is composed of a bottom piece 12 x 14 in. of full length and an upper piece 10 x 10 in. extending only between the trusses. With the 10 x 10-in. beam supported by blocks 46 in. from the trusses, the bending moment in the combined beam was reduced to an allowable amount. When the material had been delivered on the ground, the bridge was completed in about ninety working days. Considerable time was lost and also about $2,000 expended in replacing falsework carried away by the sudden breaking up of the ice in the latter part of January.

In the construction of this bridge Mr. Kirkham was very much handicapped at the start by being unable to find men experienced in the construction of wood

truss bridges. As a result he had to pick up local men and teach them to do the work, aided by his two assistant field engineers, C. J. Laughlin and M. X. Wisda. The framing was done at the site and templets were used throughout on account of inexperienced men being employed. Owing to the timber being green, the

FIG. 2—TIMBER HIGHWAY BRIDGE, CHEYENNE RIVER

trusses were constructed with somewhat excessive camber and the vertical rods were tightened twice after the bridge was completed. The camber in the trusses was maintained in this manner. The greater part of the truss erection was done with the aid of a gasoline hoist.

Other Force-Account Bridges—The first bridge constructed on the force-account system was the White River bridge at Kadoka, which consists of two 150-ft. riveted steel spans on concrete foundations. The total cost, including one concrete pier and two abutments and the two steel spans complete, was about $29,000, which was about $12,000 less than the work was estimated to cost by contract. At the start Mr. Kirkham, bridge engineer, had only one experienced man, this being his field engineer, C. J. Laughlin, who had had considerable experience as a rigger and as a general concrete construction superintendent. It was necessary to employ local men and train them to do the work. Some of the men employed were experienced in pile-driving and mixing concrete but none had had experience in raising steel or riveting. They soon developed into a good crew, however, and the work was satisfactorily completed.

This same crew was moved from the White River bridge to a bridge over the Belle Fourche river, nineteen miles north of Underwood. This structure consisted of two 140-ft. riveted steel spans on concrete foundations. It was built for about $28,000, a saving of about $11,000 below a contractor's bid of $39,000. At this time the crew was enlarged to about fifteen men. By the addition of a few more men, two crews were installed, one completing the Belle Fourche River bridge and the other constructing a 65-ft. pony truss a few miles north of the Underwood bridge. These last two bridges were constructed for Meade county, and the men and the cost of material were paid directly by the county. All the work was under the general supervision of Mr. Kirkham.

The next structure built by the main crew was a 150-ft. steel through truss span over the Little Missouri River at Camp Creek, about 70 miles from the railroad. This structure, shown in Fig. 3, has concrete piers and 130 ft. of timber trestle approach. Work could not be started until the end of December, owing to the late delivery of material and the long haul, but Mr. Kirkham states that good concrete piers were built in spite of the temperature being as low as 24 deg. below zero.

The gravel, sand and water were heated and the concrete was placed in the forms at a temperature of about 90 deg. The piers were housed with canvas and timber and heat was applied under the inclosure for about ten days. The entire work was completed in less than sixty days at a cost of $14,600. This work was directly under the supervision of M. X. Wisda, field engineer.

Tar-Wood Flooring—Maintenance of plank floors on old steel bridges is a large item in the bridge maintenance expense, which is paid by the counties. Mr. Kirkham points out that the cost of maintaining ordinary plank floors is much greater than is usually realized. For instance, a rancher or a farmer may notify the county engineer or county officials that a plank is broken, rendering the bridge floor dangerous, on a bridge perhaps fifteen miles from town. If repairs are not made, the county is liable to very heavy damage cost if an accident occurs. As a rule, therefore, it is necessary for two men to take a truck and two planks and drive out to the bridge, make the repairs and return. Many bridges are said to be completely re-floored in a few years in this manner at a cost of about $10 per foot.

To reduce this maintenance expense Mr. Kirkham has designed what he terms a "tar-wood" floor consisting of 2 x 4-in. planks dipped in boiling coal tar, placed on edge across the roadway and nailed together. This solid 4-in. floor is covered with a layer of either tar and sand or tarvia and sand, about ½ in. thick. Its weight is only about 17 lb. per square foot, including the top coating, so that old light steel bridges will carry this floor when they will not carry a concrete floor. This new floor is said to be really lighter than a double layer of plank.

Crude coal-tar for dipping the planks can be purchased for 8 to 10c. per gallon, and ordinary workmen can do the work. The county crews can dip the planks during winter and pile them up in the county yards

FIG. 3. STATE CREW ERECTING STEEL TRUSS SPAN

ready for building floors whenever re-flooring is required. Mr. Kirkham believes that a floor of this construction subject to ordinary country traffic will last for twenty years. Creosoted lumber flooring is much more expensive. Since the continuity of the "tar-wood" floor distributes the loads well over the floor system it is found to increase the rigidity of the structure as a whole. This construction is somewhat similar to the flooring used on some of the Chicago viaducts, as described in *Engineering News-Record*, Nov. 13, 1919, p. 866, but this Chicago design has alternate planks of different depths in order to form a grooved surface.

Finished Road Grades Produced by Tractor Outfits

Tractor-Hauled Blade Grader Work So Highly Perfected in Northern Wisconsin that Finished Road Grade Is Produced at a Cost of $300 to $700 a Mile

By J. R. McLean
Division Engineer, Wisconsin Highway Commission, Superior, Wis.

COMPLETED road grade, without hand finishing and meeting Federal Aid acceptance requirements, is being regularly produced in Wisconsin with tractor-hauled blade graders. It should be emphasized that the grade is fully completed with sloped ditches and roadbed trimmed ready for finishing the subgrade. This result is being accomplished at a cost of from $300 to $700 a mile.

All road builders are familiar with the work of the horse-drawn blade grader generally a 6-ft. machine. The next step was the substitution of the steam or gas tractor for the horse. With more power available it was but a short time before there was a demand for a larger grader as the 6-ft. type would not stand

ROAD GRADE FORMED AND FINISHED WITH TRACTOR HAULED BLADE GRADERS

the work; 8-ft. blades were then used and the size of tractors increased. With the increase in the size of the grader there was a noticeable improvement in the work and a decrease in the cost. Tractors and graders were gradually increased in size year after year and as a result we have grading outfits today that can grade from one-half to one mile of 26-ft. road per day at a cost very little in excess of the work done in the days of the horse-drawn grader.

Equipment for Tractor Grading—The equipment for this work should include a large tractor, preferably a 15-ton caterpillar and not less than a 10-ton or a 40-60 tractor of the best possible design. The caterpillar is the best as it has better traction on the average job regardless of soil or weather conditions. It will work in any soil that the grader will handle whenever the earth is dry enough to grade and with a good operator will go anywhere required on even the worst grading job. It has ample power at a low rate of speed to handle a large grader with a full load, which means that it will not tear the grader to pieces as it would if traveling fast. The slow speed gives the operator plenty of time to handle the grader, which is very important if one is going to produce a good job. There are no exposed gears to collect dirt and dust as on the four-wheel type and, with proper care, there is very little mechanical trouble.

A 10-ft. blade is the smallest size that should be considered; a 12-ft. is better. It will move more dirt and move it farther towards the center and being of greater weight it is able to do much heavier work. This means the elimination of much hand labor both in clearing and grubbing and in picking rock. The cross-section generally used on our gang maintenance work has a ditch about 2 ft. in depth, 30 in. wide at the bottom with 1½ to 1 slope on the outside and nearly 2 to 1 on the inside. A 10-ft. blade when set at the proper cutting angle is not long enough to move the dirt out of the ditch and up onto the shoulder. This means that the 10-ft. blade must make an extra round to place the dirt upon the roadbed.

When grading the lighter soils it is nearly impossible to put the grader part way over on the shoulder of the road to move in this dirt and at the same time keep a straight shoulder line as there is a constant tendency for the grader to slip towards the ditch, especially if loaded. A 12-ft. blade will move the dirt from the ditch clear to the top of the shoulder, where it can easily be handled by the grader on the next round.

The grader should be equipped with a bank sloper so designed that it may be adjusted for the proper slope and strong enough to stand the strain. A number of the slopers on the market are totally unfit for use as they are either too light for this kind of work or cannot be adjusted.

A 40-ft. steel cable should be used to attach the grader to the tractor. By using a long cable the grader may be kept running in a straight line with very little attention, regardless of the path taken by the tractor.

During the past year some counties have used two graders and tractors on the same job, thus speeding up the work and at the same time decreasing the overhead. This provides a smooth road for traffic at all times, which is very important if working on a trunk line. Other equipment will be required to supplement the grader, especially if there is any dirt on the job which must be moved either ahead or back, which is generally the case in choppy, hilly country. If the hauls are long, wheelers will be required; if not, four-horse fresnos. In this work a plow team can be dispensed with and the wheelers or fresnos will pick up the loose dirt turned into the road by the grader, hauling it to the low places. A few small tools for cutting brush and hauling rock will be found necessary, but no finishing tools, as all this work should be done with the large outfit.

A complete camp outfit consisting of bunk and cook car, mounted on wheels, should be included in every grader outfit and if possible a tank wagon for gas.

12-FT. GRADER WITH BANK SLOPER FINISHING A DITCH

All equipment is portable and when moving day comes the grader and camp outfit can easily be towed to the next job with the tractor, and the wheelers, fresnos and small tools taken care of with the teams. Moving costs with this kind of an outfit are very light as one can pick up and get under way on a moment's notice.

Methods and Organization—Instead of the usual slope stakes, plain stakes are used to mark the ditch line. These will be set every station at a constant distance from the center line to enable the grader man to cut a straight ditch line. Stakes should be high enough to be plainly visible above the weeds and small brush as it is quite necessary to have at least two or three stakes in sight at all times. After the road limits are staked out, all stumps and rubbish are removed, using the tractor to pull the stumps and trees. Trees up to 15 in. in diameter can be pulled with a caterpillar tractor without grubbing. The first round is made keeping just inside of the stakes and cutting only deep enough to get below the tough, rooty sod. This material is carried in on the next round and spread out between the shoulders. The grader then returns to the ditch, cutting as deeply as possible, thus getting loose material with which to cover up all sods brought up before. On the second round in the ditch the grader man should pay particular attention to drainage, taking care to see that his ditch will drain at practically all points and taking out any little kinks left from the first round. No definite rule can be given for setting the grader blade. It should, however, be adjusted so that the dirt will slip back along the blade with a very slight forward motion, otherwise there will be a tendency to carry too much dirt in front of the machine. This will mean a hard riding road.

A proper organization for the tractor grading outfit should include above all a first-class grader man, a tractor operator, a straw boss to run the team outfit, wheeler holders, dump men for the wheeler gang and a few laborers. The grader man must absolutely know the cross-section which is wanted; that is, he must have a mental picture of the road desired before he starts work and he must be able to recognize the required cross-section when he sees it. He must also have a good eye for grading to eliminate all sags and waves as the work progresses by having the team outfit fill in the low spots.

The tractor man must keep his machine running without delay. This means that he must be prepared to put in over-time as it costs too much to stop the outfit during working hours. He must also pay some attention to what is going on behind him. Indifference on his part will often cause the grader man needless trouble, even to the extent of making an extra round with the outfit to remedy some kink or to get under a rock which he had to pass up on the previous round on account of the speed, not daring to hit it at a high rate of speed. In other words, the tractor operator should watch the grader man constantly.

The man in charge of the teams should be a man who understands moving dirt and with an eye for the work so that he can follow the grader man's instructions without trouble. The number of teams used in this work will of course vary, depending upon the topography of the country and the grade line desired. The idea is to put on teams enough to cut down the high spots as fast as the grader brings in the dirt. The more teams the better the grade line. No plowing is done as all dirt to be handled has been loosened by the grader. On the shorter hauls the fresnos do this work very rapidly. Four or five large fresnos will accomplish wonders in improving the grade line and

TWO-TRACTOR OUTFIT GRADING 24,000 FT. IN 19 DAYS

as they require no snatch team and only one man to hold them, they provide a very flexible outfit which can be worked in a gang or separately as the occasion may demand. No dump man is required as the straw boss and grader man will attend to placing the dirt. As the grader makes the rounds, more material is brought up and that hauled ahead smoothed off. All rocks and roots loosened by the grader are taken care of by the team outfit. When the soil is very rocky it is a good plan to have extra laborers to keep all rock picked out as fast as they are deposited on the roadway. Rock from 2 to 3 ft. in diameter can be rolled out by the grader and then hauled off by the teams.

After the grader has made two rounds in the ditch and placed the material on the roadway, a sloper is put on. With a grade so designed that it can counteract the side pull of the sloper, it is a very simple matter to trim the bank up to 4 ft. in height as the wheels on one side of the grader are running in the ditch which

should be straight and quite uniform as to grade by this time. All dirt trimmed off by the sloper is picked up by the blade and moved towards the shoulder. The second round in the ditch with the sloper should finish the banks. However, in constructing a wide ditch section the sloper should be left in place to help with the finishing. In this work the grader works from the bank towards the roadway, shaping and smoothing up the ditch as the work progresses.

After the ditches are cut, the traveled way is smoothed up. This is a very important part of the work and should not be slighted. All waves must be taken out and the entire roadbed brought to a uniform cross-section. This work does not take long, but at that is too often neglected and what would have been a good job is only a fair one because of the poor finishing. A good man will keep his ditches straight and down to grade, his shoulders straight and roadbed uniform. He knows that he cannot finish the job in one round so only cuts what dirt the blade will handle, keeps the blade set at an angle which gives the greatest lateral and yet free motion to the dirt; keeps the machine in repair, well oiled and greased and above all the road in shape for traffic to get over without trouble. In order to build a 26 ft. roadway through even flat country, at least twelve rounds must be made and with inexperienced workmen even more. Before the grader outfit has made its last round, the team outfit should have completed its work in order that the grader will have a chance to shape up the work.

Cost of Tractor Grading—The cost of this kind of work will naturally vary according to soil conditions, topography, class of help, etc. In this section the cost per mile is from $300 to $700, including lost time on account of weather and moving. The time required to complete a mile of road varies from two to six days. Either a 10- or a 15-ton caterpillar will use from 30 to 35 gal. of gas and 5 gal. of oil and grease; depreciation and overhead will be at least $20; the tractor and grader men will cost at least $12 more. The total cost is small compared with other methods of moving dirt.

Iowa Road-Maintenance Costs

The cost per mile of highway maintenance in Iowa for three years is summarized by W. H. Root, maintenance engineer, as follows:

Year	—Earth— Miles	Cost	—Gravel— Miles	Cost	—Paved— Miles	Cost	—Total— Miles	Cost
1920	5,760	$224	792	$364	67	$79	6,619	$241
1921	5,223	297	1,157	451	236	89	6,616	317
1922	4,723	270	1,558	377	334	118	6,615	288

These maintenance costs may also be classified as follows:

Year	Patrol Average per Mile	Gang Average per Mile	Equip. and Tools Average per Mile
1920	$123	$96	$22
1921	174	93	50
1922	177	68	43

Neither of the tables includes bridge maintenance or special case maintenance. Special case maintenance is classified in some states as "additions and betterments." It is work which in expediency is paid from maintenance funds but which is not strictly maintenance work. The following table shows the total expenditure per mile from maintenance funds.

Year	Average per Mile Maintenance Proper	Bridge Maintenance	Special Case	Grand Total
1920	$241	$0	$0	$241
1921	317	1	14	332
1922	288	3	14	305

How the Suburban Railways of London Handle Traffic Through Fog

London Correspondence

THOSE who have the good fortune to live in fogless cities have no conception of the inconvenience entailed to those who travel to and fro from London in the course of their daily work.

The railways serving the London suburbs have posters printed which are dug out at the beginning of the fog season and exhibited at all suburban stations intimating that "the company will not be held responsible for delays to traffic caused by fog," and so on. Invariably two or three trains per hour are cancelled, involving a reduction of 30 per cent, if not more, of the line's carrying capacity, and the passengers who would normally travel by the 30 per cent rush the remaining 70 per cent of passenger accommodation.

Delays to railway traffic through fogs are stupendous, and it is nothing for the commuter to be anything from a half-hour to an hour late at the office after a six-mile journey from his home. True, London's fogs are not so bad as they were, but they are still bad enough completely to disorganize all traffic in London; and it is nothing to see trucks proceeding through the heart of the city at a crawling pace, and a bus guided through the traffic by the conductor who walks in front carrying a lamp. Few serious railway accidents are attributable to fogs, although recently a collision occurred involving the death of several men. Trains running into bumper stops at terminals are the most common results of fogs.

When a fog descends on the London railway systems a number of men are called off the permanent way staff, doled out with a supply of fog signals and a fire in a brazier and placed in charge of the passenger safety. They take up positions at strategic points on the line and are instructed by ordinary arm signals placed close to the ground.

When this signal is at danger the fogman places two signal detonators on the rail and holds up a red lamp for the locomotive driver to see—if he can. If the line is signalled clear no detonators are placed, allowing the train to proceed. These detonators are constructed of a flat tin case loaded with black powder and caps and are fired by the pressure of the locomotive wheel. They are held on the rail by a clip. As a rule these detonators are placed on the rail by hand, though machinery is employed if the fogman has a large number of rails to care for.

The fog signal has certainly proved satisfactory so far as it goes but it is too primitive for modern traffic needs, and too costly. One trunk line uses over a half million of these signals a year and they cost a half dollar a dozen. Besides this cost there are also the wages of the fogmen whose number runs into several thousands on a "thick" morning.

On the rapid transit lines signals are placed along the track side to synchronize with the ordinary signals with the lights at eye-level. This method is fairly effective on the subway system but the only way in which the lines, both trunk and subway, can be made entirely independent of fogs is by the adoption of automatic train control, upon which a committee reported recently. It is estimated that equipping the trunk lines throughout Britain with some standardized form of automatic train control would cost around £4,700,000.

Feeder Railways of 24-in. Gage in Argentina

Freight Traffic Only—Light Branches Develop District Devoid of Roads—Economic Length—Track and Equipment

LIGHT narrow-gage railways of the portable type to serve as feeders in a large agricultural district of the province of Buenos Aires, Argentine Republic, have been built by the Buenos Aires Great Southern Ry. on account of the absence of good roads and in order to develop traffic and promote further development of cultivation. There are now four 24-in. gage agricultural railway systems totaling 150 miles.

The country is mainly flat and has a rich earth soil so that the frequent heavy rains during the winter months make access to the stations on the broad-gage (5 ft. 6 in.) main lines a difficult and costly matter. In fact the producers or farmers have been at the mercy of the local carters, with the result that charges for this service were excessive. Since the main traffic in the potato-growing zone is carried during the winter, the introduction of the light agricultural railways has been a great benefit to the farmers. Similar conditions exist in the cereal-growing zone, although the bulk of the traffic in this case is carried during the late summer and early fall. Climatic considerations vary considerably, however, and in recent years the roads have frequently been impassable for long periods, irrespective of the season of the year.

It was thought at first that the railways might be laid along the public roads. But a little investigation showed that in such a position they would be liable to serious accidental and wilful damage by the heavy carts which travel these roads and are sometimes drawn by as many as twenty-five horses. Further, the light earthworks would be subject to damage by stray cattle. In view of these conditions the lines have been built across country. Of four separate systems, two are in flat country and two in rolling or hilly country. Three of these have been laid to serve cereal traffic while the traffic of the fourth and principal system is composed almost entirely of potatoes.

Farmers and producers made considerable objection to the railways in the early stages of the project, but as their great utility and benefit was soon proved this opposition has been replaced by urgent appeals for additional lines reaching other centers. Strong opposition was made also by the local carters, who had a complete monopoly of the transportation, but when they realized that there was no hope of successful opposition they turned their activities towards developing business at points beyond the influence of the railway.

It has been found that for railways of this class to be an economic and financial success they must extend considerably beyond a radius of fifteen miles from the main line station, as business within this area is subject to strong competition. The selection of sections to be served was governed by the extent of land already under cultivation and the possibility of further large areas being developed as a result of the construction of a feeder line.

FIG. 1—OLD AND NEW TRANSPORTATION SYSTEMS IN COUNTRY DISTRICTS OF ARGENTINA

Note immense wheels of wagons hauled by 10 to 25 horses when loaded. Agricultural railways supersede wagons.

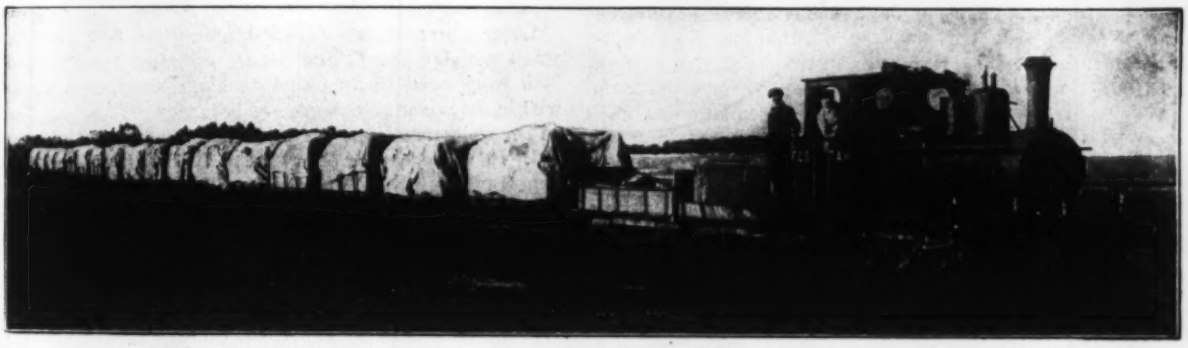


FIG. 2—TRAIN ON 24-IN. FEEDER LINE OF BUENOS AIRES GREAT SOUTHERN RAILWAY

Adoption of the portable type of railway of 24-in. gage (60 cm.) was influenced largely by the fact that extensive experience in other parts of the world and particularly in France during the World War had proved this type of line capable of carrying large volumes of traffic successfully and economically. Furthermore, it provides a certain flexibility of operation since the track can be moved readily from one location to another, or removed and relaid in some more productive zone.

Track construction consists mainly of 20-lb. rails bolted to steel ties, with seven ties to each rail length of 15 ft. In a few stretches where traffic is intense 30- and 58-lb. rails are used in 25-ft. lengths spiked to nine or eight hardwood ties, respectively. Ballast consists only of the local earth. Streams are crossed by timber trestles, except that on the main line old steel girders from the broad-gage lines are used, with brick substructures. The ties are laid directly upon the girders. Passing sidings, which serve also as loading tracks, are provided at 3-mile intervals. Stub end sid-

ings for loading are built as required to serve the cultivated areas. There are no stations or signals. The maximum grades are 1.25 per cent for the outbound or empty direction and 0.66 on the inbound or loaded direction. Curves of 164-ft. radius are the minimum on open line and 131.2 ft. in yards, except for 98.4 ft. at turnouts with No. 4½ frogs.

The average traffic consists of eight freight trains daily. No passenger trains are operated as yet. Steam locomotives of the 4-6-0 type, weighing 12 tons and rated at 45 hp., can haul trains of seventeen cars of seven tons capacity, while 6½-ton four-cylinder gasoline engines of 40 hp. can haul twelve cars. These 7-ton cars weigh 2.3 tons and have brass bearings; 6-ton cars with ball bearings weigh 1.3 tons. All cars are mounted on four-wheel trucks.

These railways were built under the direction of R. G. Garrow, chief engineer of way and works of the Buenos Aires Great Southern Railway, Buenos Aires.

Discharge Through Adjustable Submerged Orifices

Experiments Made at Sacramento and Fort Collins Lead to Increased Accuracy of Measuring Irrigation Water

By H. A. Wadsworth
Instructor in Irrigation Practice,
College of Agriculture, University of California

Although the measurement of irrigation water through submerged orifices has long been a common practice in California and other western states the results from such measurements have always been subject to question because of the inaccuracy of the device. Nevertheless, many western canal companies accept this inaccuracy and continue the use of the

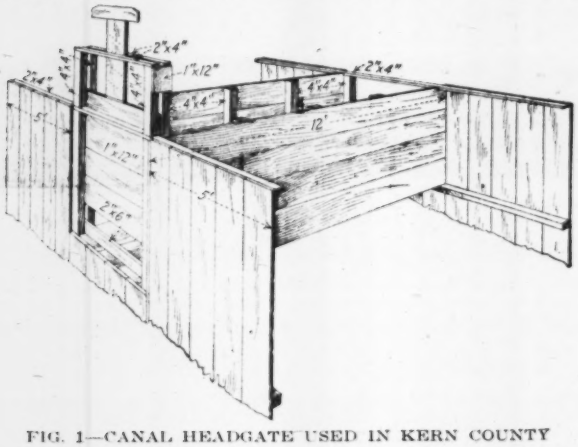


FIG. 1—CANAL HEADGATE USED IN KERN COUNTY

adjustable submerged orifice in the computations of their water charges. Other canal companies, especially where ditch grades are flat and where the discharge may be subject to wide and sudden fluctuations, use the device because no better one is available.

During the spring and summer of 1922, the College of Agriculture, University of California, in co-operation with the Bureau of Public Roads, Department of Agriculture, began a series of experiments aimed toward increasing the accuracy of the adjustable submerged orifice as a means of measuring irrigation water. The work was carried on at the field laboratory at Davis, Calif., and at the hydraulic laboratory at Fort Collins,

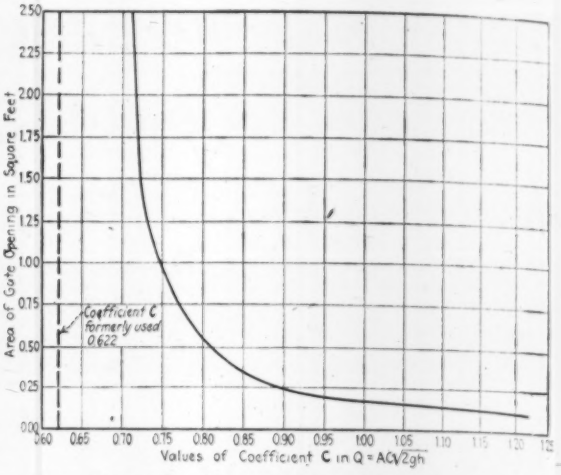


FIG. 2—EFFECT OF AREA ON *C* IN KERN COUNTY LAND CO. FLUME

Colo. Briefly, the experiments indicate that the size of opening is a decided factor, as are contractions and suppressions, and a new equation has been developed.

From the time of its introduction as a means of measuring irrigation water until about ten years ago it was assumed that the common formula for the discharge through sharp-edged orifices of fixed areas would hold for crude timber gates as well. A value of 0.61 was consequently assigned to C in the equation

$$Q = AC\sqrt{2gh} \qquad (1)$$

Later observations demonstrated that 0.61 was too small a value for C and values ranging from 0.65 to 0.85 were used in an effort to make the device record within an acceptable degree of accuracy. This variation in the coefficient was attributed to structure differences.

In 1920 the Kern County Land Co., after considerable experimenting with headgates of the type in use on their system determined that the value of C was a function of the area of the opening. For very small openings of the gate conditions approached those of a short tube and the value of C became almost unity. Fig. 2 shows the effect of the area upon the value of C for the type of gate used by the Kern County Land Company. The type of gate used at the university is shown in Fig. 3.

Gates of this type were installed in the open air laboratories at Davis and at Fort Collins and 146 tests

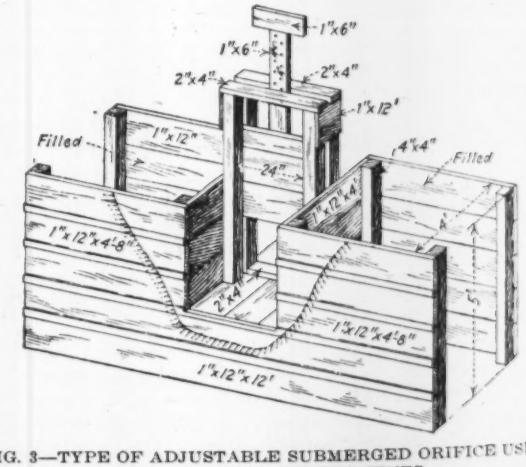


FIG. 3—TYPE OF ADJUSTABLE SUBMERGED ORIFICE USED IN UNIVERSITY EXPERIMENTS
Bottom and side contractions are partially suppressed.

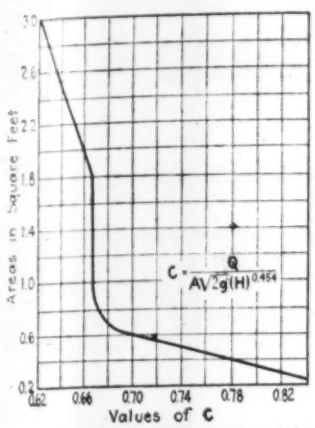


FIG. 5—VALUES OF C FOR LABORATORY GATES

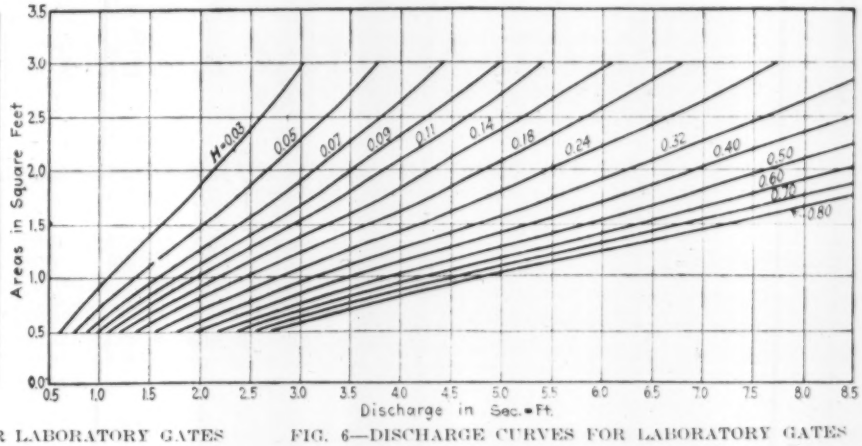


FIG. 6—DISCHARGE CURVES FOR LABORATORY GATES

run against standard rectangular weirs. These tests covered a range of discharge of from 0.5 to 13 sec.-ft. and a range of areas of from 0.3 sq.ft. to 3 sq.ft. The differences in head were carefully measured with hook gages. These hook gages were so set that they measured the elevation of the water level 10 in. above and 10 in. below the plane of the gate. These gages and the details of the laboratory installation are shown in Fig. 4. In computing the resulting values of C by the old formula it was found that C was not a simple function of the area. A new formula was devised.

$$Q = CA\sqrt{2g} \times H^{0.454} \qquad (2)$$

When this formula was used, the points were grouped to much better advantage. Fig. 5 shows the resulting values of C when plotted against the areas.

For convenience in the field a table has been prepared which will give the discharge through a submerged orifice of this type by two multiplications. Fig. 6 is a graphic presentation of the same relations. Repeated tests show an error consistently less than 5 per cent.

This formula only holds for gates of the type shown in Fig. 3. Changing the width of the gate would probably effect the discharge although the active area remained the same. Changing the size of the gate guides would probably effect the contractions to such an extent that the formula would not hold.

VALUES OF "$2\sqrt{2g}.(H)^{0.454}$" AND OF "C" IN THE FORMULA
$Q = A\,C\,\sqrt{2g}\,(H)^{0.454}$
FOR DISCHARGE THROUGH SUBMERGED ORIFICES OF THE TYPE SHOWN IN FIGURE 3

H Ft.	$\sqrt{2g}\,(H)^{0.454}$	A Ft.	$\sqrt{2g}.\,(H)^{0.454}$	H Ft.	$\sqrt{2g}\,(H)^{0.454}$	A Sq. Ft.	C
0.01	0.992	0.41	5.35	0.81	7.29	0.2	0.855
0.02	1.41	0.42	5.41	0.82	7.33	0.3	0.816
0.03	1.63	0.43	5.47	0.83	7.37	0.4	0.777
0.04	1.85	0.44	5.53	0.84	7.41	0.5	0.738
0.05	2.04	0.45	5.59	0.85	7.45	0.6	0.700
0.06	2.22	0.46	5.65	0.86	7.49	0.7	0.680
0.07	2.39	0.47	5.71	0.87	7.53	0.8	0.672
0.08	2.53	0.48	5.76	0.88	7.57	0.9	0.668
0.09	2.68	0.49	5.81	0.89	7.61	1.0	0.667
0.10	2.80	0.50	5.86	0.90	7.65	...	.....
0.11	2.93	0.51	5.92	0.91	7.69	...	.....
0.12	3.07	0.52	5.97	0.92	7.73	...	.....
0.13	3.18	0.53	6.02	0.93	7.77	...	.....
0.14	3.29	0.54	6.07	0.94	7.81	...	.....
0.15	3.39	0.55	6.12	0.95	7.85	...	.....
0.16	3.49	0.56	6.17	0.96	7.83	1.8	0.667
0.17	3.58	0.57	6.22	0.97	7.92	1.9	0.664
0.18	3.67	0.58	6.27	0.98	7.96	2.0	0.660
0.19	3.76	0.59	6.31	0.99	7.99	2.1	0.656
0.20	3.85	0.60	6.36	1.00	8.02	2.2	0.652
0.21	3.94	0.61	6.41	1.01	8.06	2.3	0.648
0.22	4.02	0.62	6.46	1.02	8.10	2.4	0.644
0.23	4.10	0.63	6.51	1.03	8.13	2.5	0.640
0.24	4.18	0.64	6.56	1.04	8.17	2.6	0.636
0.25	4.26	0.65	6.60	1.05	8.20	2.7	0.632
0.26	4.34	0.66	6.65	1.06	8.24	2.8	0.628
0.27	4.41	0.67	6.70	1.07	8.27	2.9	0.624
0.28	4.48	0.68	6.75	1.08	8.30	3.0	0.620
0.29	4.55	0.69	6.79	1.09	8.33	...	.....
0.30	4.62	0.70	6.83	1.10	8.36	...	.....
0.31	4.70	0.71	6.88	1.11	8.40	...	.....
0.32	4.77	0.72	6.92	1.12	8.44	...	.....
0.33	4.84	0.73	6.96	1.13	8.48	...	.....
0.34	4.91	0.74	7.00	1.14	8.51	...	.....
0.35	4.98	0.75	7.04	1.15	8.55	...	.....
0.36	5.05	0.76	7.08	1.16	8.58	...	.....
0.37	5.11	0.77	7.12	1.17	8.62	...	.....
0.38	5.17	0.78	7.16	1.18	8.65	...	.....
0.39	5.23	0.79	7.20	1.19	8.68	...	.....
0.40	5.29	0.80	7.24	....	....	...	....

FIG. 4—LABORATORY INSTALLATION AT FORT COLLINS

The experience of the U. S. Reclamation Service and Kern County Land Co. shows that with complete contraction on sides and bottom, H has an exponent of 0.50. The present series shows that incomplete suppression of the side contraction results in an exponent of 0.454 for H. Still further suppression of the side contractions, such as would result by replacing the 4 x 4-in. gate posts by 2 x 4-in. posts, might reduce this exponent further.

Engineering Literature

A MONTHLY REVIEW OF BOOKS AND A LISTING OF NEW PUBLICATIONS

Improved in Rewriting

REVIEWED BY LEONARD METCALF
Consulting Engineer, New York City

ENGINEERING ECONOMICS: First Principles—By John Charles Lounsbury Fish, M. Am. Soc. C. E., etc., Professor of Railroad Engineering in Stanford University, Author of Earthwork Haul and Overhaul. Second Edition. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 311. $3.

The second edition of this book shows marked advance in the author's conception and presentation of this subject. "The first edition," the author states, "dealt with economic choice of structure." The author now holds "that the fundamental problem of engineering economics is not choice of structure but, rather, choice of investment." This has involved a different sequence of presentation, a rewriting of the book—"a new writing that should begin with the problem of investment and follow the path indicated by the analysis."

The author first stimulates the interest of his student by the analysis of an apparently blind problem of investment. Then he introduces the effect of the factor of time, through a discussion of simple and compound interest, sinking funds, annuities, etc., and discusses depreciation allowance, operating and maintenance costs, and interest on capital. Four chapters follow on analysis of first cost—preliminary expenses, materials and labor, overhead costs, etc., and then on business units—the use of borrowed capital, the individual business, the partnership, private and business corporations.

A chapter is then devoted to "irreducible data on the problem of investment," based on the author's previous discrimination between reducible and irreducible data. "A quality whose effect on choice can be numerically expressed" is defined as "a reducible datum," and an irreducible datum as "a quality whose effect on choice cannot be so expressed." The choice of terms is unfortunately not suggestive, as under "irreducible data" the author includes data pertaining to safety of principal, safety and uniformity of yield, liability, marketability, collateral value, duration, control, management, units, probability of appreciation.

Then come chapters upon financial statements, cost keeping, miscellaneous forecasts on output, life, period of service, interest rate, population, earnings, price and wage rates; and two chapters devoted to valuation, including formulas for determining depreciation and salvage value. A brief chapter on "errors in estimating," and one on "engineering reports," conclude the text. In the appendix are given specimen incorporation papers, tables of formulas and of values, a bibliography, and a set of questions and problems.

The book marks a distinct step in advance over the first edition. The formulas and tables submitted are concise and helpful. Though the book is better adapted to classroom use than to the needs of the engineer, it will be read with interest by engineers.

It is probably not fair for the practicing engineer to criticize the teacher in his method of attacking his subject, but practical experience with young designing engineers suggests that a somewhat more direct presentation would be less formidable to the student and more likely to leave a lasting and friendly impression. It is desirable that the student should retain a lasting impression of the fundamental importance of this subject to him in his later work. A presentation of simple, and later more complex numerical problems, bringing comparisons and methods of analyses clearly before the student would be more effective and preferable to discussions, however clear and concise, which require not only close concentration but a fairly good knowledge of the subject to make the author's intent clear.

Revision of Eckel's Cements

REVIEWED BY P. H. BATES
Chemist, United States Bureau of Standards, Washington, D. C.

CEMENTS, LIMES AND PLASTERS: Their Materials, Manufacture and Properties—By Edwin C. Eckel, C. E., Affiliate Am. Soc. C. E.; Fellow, Geological Society of America. New York: John Wiley & Sons, Inc. Cloth; 6 x 9 in.; pp. 655; halftones and line cuts. $6.50 net.

The first edition of this volume (1905) was undoubtedly the best publication dealing with the sources of raw materials, the manufacture, testing, theories of constitution and hardening and using of all the common structural cements ever issued. If any adverse criticisms were to have been made at that time they would have referred to insufficient discussion of foreign conditions and a lack of foreign references—a lack which was completely overshadowed by the nice balance maintained throughout in the presentation of the matter pertaining to each cement. The author had avoided the tendency so marked in works of this type of getting lost in the endless detail of plant design and equipment. Such important and far less accessible information as the geology and quality of the sources of raw materials, the discussion of what takes place during burning, the theories of what the products are, what takes place when they set and harden, etc., was given in such completeness that the volume immediately attained the preëminence that it deserved and has maintained.

Although the present edition has over 100 pp. of new material it contains 57 pp. less than the older one, the reduction being about equally divided between the parts devoted to natural and portland cements. The revision is not as thorough as one would have expected after a lapse of seventeen years.

Based upon rate of increase of production the author has paid more attention to the revision of the matter dealing with portland cement than with other parts of the book. The wisdom of this is questionable. Lime is used more universally today than ever before although in certain classes of work it has almost reached the saturation point. According to figures cited, the value of hydrated lime in 1920 almost equaled the value of the entire lime industry in 1903. Surely this rather new product deserves more comment than in 1905, especially in relation to its use with portland cement in concrete. Enough has been published since then deal-

ing with this one application of a lime product to fill a volume of a size equal to the one in question. The several associations interested in lime products have been very active in research and much valuable information has been rendered available since 1905. The gypsum industry has also made rapid strides forward and such products as gypsum block for non-load bearing walls and roof slabs and monolithic gypsum construction now overshadow the majority of other uses of gypsum but they are not mentioned.

The author refers to the fact that magnesia and oxychloride cements have increased in use at a rate exceeded only by that of portland cement (289 and 312 per cent, respectively), nevertheless the part devoted to this cement is "as was." The two methods given for the separation of lime from magnesia are of theoretical interest only, but the method used almost entirely for obtaining the magnesia from dolomite for the "85 per cent magnesia insulation" industry is not mentioned, nor is this absolutely essential product itself. The very rapid increase in the use of magnesia stucco calls for no comment other than a few formulas, which incidentally contradict the author's statement, in the introduction, that these cements have the least sand carrying capacity of all cements. The portion of the volume dealing with these three cements—lime, gypsum and magnesia—deserve as much careful revision as that devoted to portland cement.

A small amount of new material appears in the part devoted to hydraulic limes, grappiers, etc. The suggestion that these should have more attention in America on the basis of their cheapness is not borne out by domestic conditions. In this country even lump lime costs more than portland cement and both of the above mentioned products require further treatment in their manufacture than does lump lime. Hydraulic limes would cost more than portland cement in this country if manufactured on the same scale as lime, either lump or hydrate; even if manufactured in as large units as portland cement they could not be sold much cheaper.

The part devoted to natural cement has been materially reduced and doubtless rightly so. Quite properly the author allows this valuable cement to sink further into an oblivion originally induced solely because those manufacturing it could not unite on a statement of what its quality should be and what it should do in service and keep its qualities before the public.

Part VI, dealing with portland cement, shows the most revision, although at least 75 per cent of the old text is reproduced verbatim. Generally the new matter is good but attention should be called to the definition of portland cement according to which it is not necessary to clinker the raw mix. The discussion of costs and prices is interesting and is presented with special reference to the use of index numbers. But it is questionable if few besides economists will be impressed with the figures given in Table 215, showing a decrease in "True Price" from $0.995 in 1913 to $0.829 in 1920 when they recall, as shown in the same table, that "the price per barrel in currency" rose from $1.005 to $2.01.

The chapter devoted to testing and physical properties is unfortunately unchanged notwithstanding the great amount of work which has been done along these lines and published by the American Society for Testing Materials through its Committee C-1, which has issued a publication of 378 pp. discussing test methods and the results obtained from the use of different methods.

Only a page is given to the work of Rankin and his colleagues at the Geophysical Laboratory. This has been the most outstanding and conclusive work ever done in elucidating the question of what portland cement is. Older disproved theories are given considerably more prominence. No attention is called to the revision of Newberry's formula as given by himself and based on Rankin's work in Chapter V of the 1916 edition of Thompson's "Concrete: Plain and Reinforced," although the old formula is reproduced. One very striking omission is that of any discussion of waste heat boilers, which have been the source of the greatest economy in the industry since the introduction of the rotary kiln.

A series of specifications is given, starting with those of the New York State Canal of 1896 and ending with those of the U. S. Government, 1917, which are wrongly stated to be "Revised to Date." Nothing is said in regard to the "American Standard" of the American Engineering Standards Committee which is the latest standard arrived at through the co-operation of the U. S. Government and the American Society for Testing Materials.

The concluding portion, dealing with puzzolanic materials, is largely as in the 1905 edition. These are cements which are used but little and intermittently.

This review may seem to be unduly adversely critical, but the reviewer feels that the author made an unfortunate mistake in not bringing his book up to date, particularly in view of the great amount of research work which has rendered many data available. The volume still remains the best of its kind but its date of issue, for most purposes, is as of 1905.

History of Engineering and Technology

THE NEWCOMEN SOCIETY FOR THE STUDY OF THE HISTORY OF ENGINEERING AND TECHNOLOGY: *Transactions*. Vol. I., 1920-21. H. W. Dickinson, M. I. Mech. E., Honorary Secretary and Treasurer, the Science Museum, South Kensington, London, S. W. 7. Paper; 8 x 10 in.; pp. 89; 18 halftone and other plates.

Formed some two years ago to collect and preserve "records, MSS., drawings and illustrations of or relating to engineering work and industrial progress," including related biographical material, the Newcomen Society has recently published its first volume of *Transactions*. The opening paper is an "Introduction to the Literature of Historical Engineering to the Year 1640," by E. Wyndham Hulme, supplemented by a brief but valuable classified bibliography. The latter is chiefly of books French, German and Italian, but contains a number of interesting entries of English works. Of the other papers in the *Transactions* the one of most interest to American engineers is "The Mystery of Trevithick's London Locomotives," by Loughnan St. L. Pendred, editor of *The Engineer*. There are also papers on early iron-making in France and early spinning machines.

It is sincerely to be hoped that the Newcomen Society's small membership of about 120 will be rapidly increased now that it has a volume of *Transactions* as tangible evidence of its usefulness. The membership is open to all interested, at the modest fee of £1 a year. Thus far there are only five American members. Libraries of engineering schools and societies, of which only two in this country have subscribed, should make the *Transactions* widely available and many other engineers might well follow the example set by L. F. Loree, president of the Delaware & Hudson R. R., in joining the society.

Two Books on Reinforced Concrete

REVIEWED BY GEORGE PAASWELL

Consulting Engineer, New York City

CONCRETE-STEEL CONSTRUCTION—PART I. BUILDINGS. A Treatise upon the Elementary Principles of Design and Execution of Reinforced Concrete Work in Buildings—By Henry T. Eddy and C. A. P. Turner. Second Edition, Rewritten. Minneapolis, Minn.: Published by the Authors. Cloth; 6x9 in.; pp. 477; line cuts and halftones. $10.

ELASTICITY AND STRENGTH OF MATERIALS USED IN ENGINEERING CONSTRUCTION. Section I—By C. A. P. Turner. Minneapolis, Minn.: Published by Author. Cloth; 6x9 in.; pp. 85; line cuts and halftones. $5.

A small book just published, "Elasticity and Strength of Materials," by C. A. P. Turner, contains some extracts from an older and larger book on elasticity, and some data on the materials of construction. The older work is Eddy and Turner's "Concrete Steel Construction," published three years ago as a second edition of a considerably smaller book published in 1909. It purports to be a complete treatment of reinforced-concrete construction, with more particular reference to flat-slab analysis; in fact it is a thesis on the special mushroom slab of which the junior author is the inventor. The following comments deal with both works.

There are excellent chapters containing historical notes; and on the elements of elasticity and on concrete construction in general. Data on residual strains are presented with remarkable clarity (in striking contrast with the presentation of most of the other matter) and should be read by every one who would attempt a rational reconciliation of theory with experimental research. The authors seem to have covered in correct fashion the matter of the initial discrepancies between test and theory.

The general discussion of flat slab action is, for the most part, shrewdly presented and *as a qualitive study* is, in its essentials, correct. The treatment of continuous girders is ably presented, gives much new matter and covers this field as completely as one would require for concrete construction.

However, the spirit in which the books are written weakens their usefulness as text and reference works. It is not so much the true action of flat slabs that is sought as it is a justification of the mode of design of the patented mushroom slab. Obviously the books are written with this specific purpose in mind and the reviewer feels justified, therefore, in discussing at large and in detail the analysis covering this design.

Probably the most disturbing feature of the books is the lack of straightforward analysis. There is no short and simple path leading from a clear hypothesis to a well-founded conclusion. The introduction of so many varied methods of attacking the problem, none leading to definite quantitative results and all, for the most part, having little bearing on the meager algebraic analysis presented, is, to say the least, confusing. The work is sadly deficient in cold logic. It seldom emphasizes what is an arbitrary assumption on the part of the authors and what is recognized physical law. The reader infers, in a number of cases, that some of the statements given are founded on acknowledged law, when as a matter of fact the statements are based upon the most arbitrary of assumptions.

The authors trifle with and distort basic law in such disconcerting fashion as to leave doubt in the reader's mind as to the correctness of the most elementary of propositions. Thus in discussing the "law of rigidities" (the well-known theorem of least work) the universal truth of the law is noted, yet a static example of work is given which leaves the reader to infer that the law has decided exceptions. The exception as given is, of course, absurd. At another point a statical moment is divided up between slab and supporting girder in direct violation of all "laws of rigidity."

It is noted that under certain conditions the law of equality between horizontal and vertical shear is not valid. If the authors had stopped to note that the equality of vertical and horizontal shear is based upon the analysis of an infinitesimal prism, where all forces are either normal, passing through the centroid of the prism, or are tangential, they would have seen that the equality of such shears is as fundamental a law as any of the laws of equilibrium. Such an error on the part of the late Professor Eddy, a very conscientious analyst, is well nigh unpardonable. It is noted that the horizontal shears at the support of a continuous girder are zero. It has been overlooked that beam action (with the famous principle of local perturbations) is no longer valid at a reaction. The distribution of the reaction vitally affects the stresses in the beam at this point and it is not beam action that must be studied, but the manner of distribution of a load through a block, a problem not yet clearly understood. The decision of the Joint Committee on Concrete and Reinforced Concrete to allow for full horizontal shears at the support has not yet received worthy mathematical refutation.

In speaking of lateral deformation under a longitudinal load (the so-called Poisson ratio), the authors revive an old error. It is the very essence of lateral deformation that it is absolutely untranslatable into lateral stress. Every law of work and statics would be violated by such equivalent true or actual stress. Professor Burr has given a very clear demonstration of the faulty analysis contained in this assumption in "Elasticity and Resistance of Materials." The practical application of the phenomenon of lateral deformation has been made the occasion of much confused analysis. In these books values varying from one-tenth to one-half appear, with little justification other than their aid in analyzing the mushroom slab.

It is probably true that an action similar to the lateral deformation occurs in a flat slab, and a two-way reinforced slab by restraining this deformation increases somewhat the resisting powers of the slab. The finer the mesh the greater the resistance may be a justifiable assumption. One can not conscientiously say any more, however, than this qualitative statement. In the newer text, the remarkable statement is found that the correct value of the Poisson ratio for isotropic materials is 0.4142, in place of 0.25, based upon the "kinetic invariance" of volume under strain; noting that, with this determination, the century-long feud between the rari- and multi-constant elasticians has been settled. However, in view of the fact that volume is *not* an invariant under strain, the author has not yet put an end to the feud.

One of the fundamental notions introduced by the authors is the existence and effect of twisting moments. It is estimated that heretofore all designers have overlooked such moments, and that the introduction of the new type of moment explains, in proper fashion, slab action. As a matter of fact, any one reading the book will appreciate that the authors have arbitrarily chosen to call one or two component bending moments a twist-

ing moment. In a very superficial sense, only, is it a twisting moment; just as in the case of a simple beam one may attempt an analysis on the basis of an applied twisting moment normal to the axis of the beam. Flexure problems are solved on the basis of bending moments and the plate problem is but little more than a problem in flexure. This does not mean that beam action and plate action are similar; the authors are correct in emphasizing the difference between beam strip action and plate action; but they fall into serious error in attempting to place the onus of the difference on the "twisting" moment. In every case noted, since the plate treated is a symmetrical surface, what is termed a twisting moment about one axis becomes a bending moment about the other, with absolutely no distinction in physical action.

It is well worth pointing out that at no place have the authors utilized (save in a qualitative sense only) the "twisting" moment. When a definite design is carried out, the famous twisting moment is ignored, as it should be, and flexure only is considered. To put it briefly, the authors have chosen, deliberately, or otherwise, to label one of two symmetrical bending moments a twisting moment and have not shown one iota of digestible analysis to justify such terminology.

To effect a practical analysis of flat slabs some arbitrary assumptions must of course be made. The general problem of the analysis of the plate under unrestricted conditions has to date proved insoluble. Some method analagous to the semi-inverse method of St. Venant in the beam problem must be adopted in plate analysis. Thus the best method of attacking the plate problem seems to lie in the assumption of zero shear planes based upon the symmetry of the plate and its loading. This is a dangerous method, since it is of obvious application only to a symmetrically loaded plate. With these assumptions static analysis proceeds and a resultant moment is found, based upon an assumed uniform distribution of loading upon supports. This resultant moment may be resolved into two component moments, at right angles to each other, but these, again, are still bending moments.

Fundamentally, the analysis of a plate is the study of the geometry of a curved surface. Gauss introduced the method of curvatures to determine the properties of the surface and elasticians have adopted this method, since curvatures determine bending moments. The twisting moment recognized among elasticians is essentially the rotation of an axis normal to the plate about itself as the plate is deformed. Such distortion is ignored in the text, and the twist has no place in the analysis.

In short, when the authors confine their attention to a qualitative discussion of plate action, they give with reasonable accuracy (ignoring the confusion between flexure and twist) what one may expect in the distortion of a flat slab under load. Beyond this point no confidence can be placed in any of the analysis presented. Distinctions between statical, external and resisting moments and attempts to combine the moment of inertia of two intersecting sections to give a resisting moment destroy most of the confidence of the reader in the design methods.

It must be remembered that no one has yet presented a successful solution of flat slab action, and the authors can not be harshly censured for their failure to present an acceptable solution. It may be mentioned in conclusion that the authors build a special type of flat slab that proves an apparent economy to the owner, carries safely all loads upon it and seems to meet, superficially at least, the qualitative requirements of flat slab action.

Forty Years of Landscape Architecture

FREDERICK LAW OLMSTED: LANDSCAPE ARCHITECT, 1822-1903—Edited by Frederick Law Olmsted, Jr., and Theodora Kimball. Vol. I. Early years and Experiences, Together with Biographical Notes. Forty Years of Landscape Architecture: Being the Professional Papers of Frederick Law Olmsted, Senior. New York and London: G. P. Putnam's Sons. Cloth; 6 x 9 in.; pp. 131. $2.50.

Publication of the first of a series of volumes under the general title "Forty Years of Landscape Architecture," a series in preparation since the death of the senior Olmsted in 1903, was achieved late in 1922, the centenary of his birth. The joint editorship by F. L. Olmsted, Jr., and Miss Kimball, of the Harvard School of Landscape Architecture, is a happy combination, added to which was the assistance rendered by the wife of the senior Olmsted at the ripe age of ninety years.

The present volume opens with some forty pages of condensed biographical notes. These are followed by a section on Early Experiences as contributions to his later career, consisting of fragments designed for an autobiography, extracts from letters, papers, books and articles by the senior Olmsted. One of the most interesting features of the book is the light it throws on what proved to be the development of a professional career; a development which for many years came wholly through breadth of study, observation, civic and human interest, with certain practical applications which prepared the way for a brilliant and useful professional life, in which the senior Olmsted was largely an American pioneer.

From the biographical notes it appears that on Dec. 1, 1836, when still under fifteen, Olmsted was ready to enter college, but that on account of weak eyes this was given up and that in November, 1837, he went "to Andover, Mass., to study engineering with Prof. Barton," a connection he maintained at Andover and later at Collinsville, Conn., until May, 1840. Interspersed with an experience in business, a voyage before the mast to Canton, China, three engagements to get practical experience in farming, and establishment as a farmer on his own land, Olmsted attended lectures at Yale, where in June, 1847, he was made an "honorary member" of the class of that year. From 1847 to 1854, Olmsted made landscape improvements on his own farm, and established a nursery, besides recording his travel observations in "Walks and Talks of an American Farmer in England," "Seaboard Slave States," "A Journey in Texas" and "A Journey in the Back Country"—the latter an account of a horseback ride from New Orleans to Richmond.

A visit to A. J. Downing in 1851, shortly before the tragic death of that pioneer and promoter of landscape design in America, seems to have been an important factor in Olmsted's final choice of landscape architecture as a profession. In 1857 he was appointed superintendent of Central Park; early in 1858 he and Calvert Vaux were awarded first prize in a competition for plans for Central Park, and a few weeks afterwards Olmsted was appointed architect-in-chief of Central Park—a connection that continued for many years, with breaks and threatened breaks due to political attacks and interference. Parks, cemeteries, private and institutional,

state and national grounds, the latter including the Capitol at Washington, with occasional engagements on village and city extension plans, occupied Olmsted more and more fully as the years went by. From 1890 on until its completion the grounds of the World's Columbian Exposition received much of his attention.

Although Olmsted died before city planning had much more than become recognized as an art and before its establishment as a profession in America, his work doubtless contributed more towards both than that of any other one man up to the time of his death: for while Downing, through his editorials in the *American Horticulturalist*, and through his books and some minor landscape planning, did much to create interest in landscape architecture and to spread sound ideas as to its fundamentals, it was left to the more practical Olmsted and to a later and riper time as well to put the slowly growing appreciation of landscape art into corporeal form through the creation and adornment of parks and other functionally designed open spaces.

Of the volumes to come in this promising series, the next will be devoted wholly to Central Park—towards the cost of which the Russell Sage Foundation has contributed because of the value of the material in connection with the survey of Greater New York and its environs, now being made. Other volumes will take up different lines of Olmsted's work; and the series will be rounded out by a general volume, with explanatory matter by F. L. Olmsted, Jr., this volume to be "an orderly and consistent presentation of the theory and practice of the landscape art as developed by Frederick Law Olmsted, Senior."

Such a series will do just honor to the great leader in the profession of landscape architecture. When may we expect equally just honor to be paid to some of the leaders of the civil engineering profession?

Federal Railroad Control

AMERICAN RAILROADS: Government Control and Reconstruction Policies—By William J. Cunningham, A. M., James J. Hill Professor of Transportation, Graduate School of Business Administration, Harvard University. New York, Chicago and London: A. W. Shaw Co. Cloth; 6 x 8 in.; pp. 409. $3.

Prof. Cunningham has set out to review American railroad history during the years 1917 to 1922 with special emphasis upon the period of federal control between Jan. 1, 1918, and March 1, 1920. During most of that time he was officially connected with the United States Railroad Administration, serving on the staff of the Director General of Railroads, first as manager of the operating statistics section and later as assistant director of operation.

In his first and second chapters the author has reviewed all too briefly the three periods of American railroad history: From 1830 to the Civil War, during which development was quite unrestrained and the public attitude one of liberality and encouragement; from the end of the Civil War until 1887, during which the roads began to reap the fruits of some of their earlier excesses and public antagonism began to show itself in the form of regulation by individual states; and finally the period from 1887 to 1917, which included the beginning of federal railroad regulation with the establishment of the Interstate Commerce Commission in 1887.

The bulk of the book deals in great detail with the events of 1917, which resulted in the assumption of government control over the operation of the roads, and with the post-war problems of the carriers. This section closes with a review of the Transportation Act of 1920 and of its operation during 1921. The book ends with a statement of the situation in July, 1922, at the commencement of the shopmen's strike.

The elements of this subject are so numerous and the issues are so controversial that it would be exceedingly difficult for any one to handle them to the general satisfaction in so small a compass. For example, the chapter on the financial results of the period of federal control comprises only six pages. There are few railroad executives whose views on this subject alone could be set forth to their satisfaction in six books of the dimensions of this one. It is probable, however, that this very condensation contributes in no small measure to the value of the book, for it is an exceedingly handy reference text for any one who may have occasion to review quickly the outstanding railroad developments of recent years so far as their governmental relations are concerned.

The Legal Side of Land Surveying

A TREATISE ON THE LAW OF SURVEYING AND BOUNDARIES—By Frank Emerson Clark of the Minnesota Bar. Indianapolis: The Bobbs-Merrill Co. Cloth; 6 x 9 in.; pp. 631; illustrated. $5.

There still remains in many sections of the West the "law" that fence-line priority means ownership. And the surveyor who goes into more or less hostile territory with only technical knowledge and training is ill-equipped even to bluff his way through difficult situations. Legal knowledge concerning what he is doing is almost as essential as technical ability.

The author of "Surveying and Boundaries," a lawyer and also a former surveyor of extended experience, supplies the field man all the legal ammunition he need carry. The volume reveals logical co-ordination of field problems with legal precedence. About 1,000 cases at law are cited.

In addition to its value as a legal friend to the surveyor, the book sets forth historical outlines of how public and private land surveys have been and are made, together with the histories of incidental problems. Of particular interest is a chapter on riparian rights, which goes into the detailed civil and technical history of scores of riparian-right controversies. Land surveyors who wish to be efficient in their work will do well to study the volume carefully.

Survey of Modern Industrialism

MODERN INDUSTRIALISM: An Outline of Present-Day Industrial Organization—By Frank L. McVey, Ph.D., LL.D., President of the University of Kentucky. Second Edition. New York and London: D. Appleton & Co. Cloth; 6 x 8 in.; pp. 358. $2.50.

By careful revision of the original and the addition of new material here and there, including three new chapters, the author has brought to date, in substance and in spirit, the excellent survey of modern industry and its relations to society and government that he wrote nearly twenty years ago while professor of political economy at the University of Minnesota; see *Engineering News*, Dec. 15, 1904, p. 552. To a consideration of industrial progress and problems in the United States, England and Germany in the first edition, the author has taken up Japan in the present volume, in a chapter on the Orient and the West. The other new chapters are on Industry and Taxation and the Widening Circle of Democracy in Industry. The revision of the opening chapter makes it a notable survey of the development of modern industrialism to the present time, embracing some of the facts and reac-

tions of the world war. The volume is in three parts: History, Industry and Administration, the latter including chapters on government interference, regulation and ownership. The author believes in the necessity of extensive government regulation and apparently some degree of government ownership, the latter to be deferred, for the most part, until government is more efficient than now.

PUBLICATIONS RECEIVED

New Books and Revised Editions

ANALYTIC GEOMETRY—By Clyde E. Love, Ph.D., Associate Professor of Mathematics, University of Michigan. Cloth; 6 x 8 in.; pp. 306; illustrated. $2.25.

APPLIED BUSINESS FINANCE—By Edmond E. Lincoln, M. A. (Oxon), Ph.D. Sometime Assistant Professor of Finance, Graduate School of Business Administration, Harvard University. New York: A. W. Shaw Co. Cloth; 6 x 8 in.; pp. 772; illustrated with charts and forms. $4 net.

On organizing and financing in various aspects; also chapters on production, selling goods, and distribution of earnings. The business cycle is considered.

DESCRIPTIVE GEOMETRY—By Lawrence E. Cutter, M. Am. Soc. M.E., Associate Professor of Mechanical Engineering, Stanford University. New York and London: McGraw-Hill Book Co. Cloth; 6 x 9 in.; pp. 244; illustrated. $2.50.

FABRICATION DE L'ACIER AU FOUR MARTIN—Par A. Barberot, Ingénieur des Arts et Manufactures, Directeur des Usines de Sainte-Marie et Gravigny, a Saint-Dizier. [Encyclopédie Minière et Métallurgy.] Paris: J. B. Bailliere et Fils. Paper; 6 x 9 in.; pp. 543; half tones and many line cuts.

HEIZUNG UND LUFTING DER BAHNHOFSCHOCHBAUTEN—Bearbeitet von Vaurat a. D. Carl Guillery in Pasing; Herausgegeben von Dr.-Ing. e. h. F. Loewe und Dr.-Ing. e. h. Dr. H. Zimmermann. Leipzig: Wilhelm Engelmann. Cloth; 7 x 10 in.; pp. 135; 82 line cuts and half tones in the text and two lithographed folding plates in colors.

LEHRBUCH DER EISEN- UND STAHLGIESSEREI—Von Bernhard Osann. Dr.-Ing. e. h. Fünfte, Neu Bearbeitete Auflage. Leipzig: Wilhelm Engelmann. Cloth; 7 x 10 in.; pp. 693; 756 line cuts and halftones.

The fourth edition of this book was reviewed by Dr. Richard Moldenke in *Engineering News-Record*, Feb. 17, 1921, p. 307.

LEHRBUCH DER ELECTROTECKNIK — Erster Band: Allgemeine. Elektrotecknik. Elektrotechnische Messkunde. Elektrische Maschinen und Apparate. Bearbeitet von F. Fischer, K. Hohage, G. W. Meyer. Leipzig, Germany: Wilhelm Engelmann. Cloth; 8 x 10 in.; pp. 753; 924 line cuts and half tones.

LEHRBUCH DES TIEFBAUNES—Erster Band: Vermessungskundo Erdboau. Stütz- Futter- Kai- und Staumaurn. Grundstrassen- Eisenbahn- und Tunnelbau, 6 B is 8 Auflage, Bearbeitet von O. Eggbert, H. Wegels, L. V. Willmann, Leipzig, Germany: Wilhelm Engelmann. Cloth; 8 x 10 in.; pp. 835; 1,475 illustrations.

THE MAKING OF INDEX NUMBERS: A Study of Their Varieties, Texts, and Reliability—By Irving Fisher, Professor of Political Economy, Yale University. [Publications of the Polak Foundation for Economic Research.] Boston and New York: Houghton Mifflin Co. Cloth; 6 x 9 in.; pp. 526; 68 "ratio charts." $7.50.

MATHEMATIK—Von H. E. Timerding, Dr. Phil. Professor in der Technischen Hochschule zu Braunschweig. Boards; 7 x 10 in.; pp. 242; line cuts. Ranges from arithmetic to calculus.

PARLIAMENTARY LAW: Method of Transacting Business in Deliberate Assemblies, Uses of the Various Motions, Method of Conducting Elections, the Duties of Members and Officers, Discipline, Model By-Laws, Forms, and Definitions of Parliamentary Terms; also Several Hundred Questions in Parliamentary Law That Have Been Submitted to the Author and the Answers Thereto—By General Henry M. Robert, Author of "Robert's Rules of Order Revised," "Parliamentary Law Charts," and "Parliamentary Practice." New York: The Century Co. Cloth; 6 x 9 in.; pp. 588. $5.

PLASTICS AND MOLDED ELECTRIC INSULATION—By Emile Hemming. New York: Book Department, The Chemical Catalog Company, Inc. Cloth; 7 x 10 in.; pp. 313; line cuts and halftones. $5 net.

Deals with ceramic products, calcareous cements and artificial stone, glass, casein products, plastics in road construction, and sundry materials in Part I, and with all sorts of molded insulation in Part II. Extensive patent lists are given for each main classification of material.

RATE MAKING FOR PUBLIC UTILITIES—By Lamar Lyndon. New York and London: McGraw-Hill Book Co. Cloth; 6 x 8 in.; pp. 209; 2 graphs. $2.

SAMPLING AND ANALYSIS OF COAL, COKE AND BY-PRODUCTS: Methods of the Chemists of the United States Steel Corporation—Pittsburgh, Pa.: The Carnegie Steel Co., Bureau of Instruction. Flexible Leather; pp. XVI 184; illustrated. $3.

The fact that this volume is designed solely for the use of the chemists of the constituent companies of the United States Steel Corporation makes it of more rather than less interest and value to any chemist engaged in sampling and analyzing the materials indicated in the title. The volume covers a wide range and contains considerable material not included in the earlier edition. The committee responsible for the book consists of a half dozen chemists, including J. R. Campbell, of the H. C. Frick Co.; and C. B. Francis, of the Bureau of Instruction.

THE TWELVE-HOUR SHIFT IN INDUSTRY—By the Committee on Work-Periods in Continuous-Industry of the Federal American Engineering Societies. With a Foreword by Warren G. Harding, President of the United States. New York: E. P. Dutton & Co. Cloth; 6 x 9 in.; pp. 302. $3.50.

Reports and Pamphlets in Various Fields

ARIZONA HIGHWAY DEPARTMENT, 1920-22—By Thomas Maddock, State Engineer. Paper; 6 x 9 in.; pp. 240; illustrated.

CALIFORNIA STATE HIGHWAY COMMISSION: Report for 1920-22—Sacramento. Paper; 6 x 9 in.; pp. 214; illustrated.

THE CARNEGIE CORPORATION OF NEW YORK: Report of Henry S. Pritchett, Acting President, for 1921-22. Paper; 6 x 9 in.; pp. 80.

CENTRAL ELECTRIC STATIONS IN CANADA: Census of Industry, 1920—Ottawa, Ont.: Dominion Bureau of Statistics. Paper; 7 x 10 in.; pp. 48.

CHIEF OF ENGINEERS, U. S. Army: Report for 1921-22. Washington, D. C. Paper; 6 x 9 in.; pp. 2257 + 38.

CONNECTICUT COMMISSION TO INVESTIGATE THE POLLUTION OF STREAMS: Report to Legislature of 1923. Paper; 6 x 9 in.; pp. 21.

Recommends creation of State Water Conservation Commission and formation of sanitary districts. Among the members of the commission were Caleb M. Saville, manager and chief engineer, Hartford Water-Works, who served as chairman, and R. A. Cairns, city engineer, Waterbury.

ECONOMIC COMBUSTION OF WASTE FUELS—By David Moffatt Myers. Washington, D. C.: Bureau of Mines. Paper; 6 x 9 in.; pp. 50; line cuts. One copy free; 10c. from Superintendent of Documents.

JAPAN DEPARTMENT OF RAILWAYS: Report for 1919-20 English Edition—Tokyo, Japan. Paper; 8 x 12 in.; pp. 120; folding colored map in pocket.

NATIONAL BRICK MANUFACTURERS ASSOCIATION: Proceedings, 1922—Indianapolis; T. A. Randall, Secretary. Paper; 6 x 9 in.; pp. 207.

NATIONAL LIME ASSOCIATION PROCEEDINGS, 1922—Washington, D. C., 918 G St., N. W. Paper; 6 x 9 in.; pp. 104; illustrated.

OREGON HIGHWAY COMMISSION, 1920-22—Herbert Nunn, State Highway Engineer, Salem, Ore. Paper; 6 x 9 in.; pp. 150; maps.

PENNSYLVANIA HIGHWAY DEPARTMENT: A Survey of the Fiscal Policies of the State Highway Department of Pennsylvania for the Citizens Committee on the Finances of Pennsylvania—By William H. Connell, Formerly Chief of the Bureau of Highways of Philadelphia. Paper; 6 x 9 in.; pp. 114; folding chart showing functional organization of the department. Address Mr. Connell (now) Deputy Highway Commissioner of Pennsylvania, Harrisburg, Pa.

An abstract of this report appeared in Engineering News-Record, Dec. 7, 1922, p. 991.

PROTOKILL DER VERHANDLUNGEN DES VEREINS DEUTSCHER PORTLAND-CEMENT FABRIKANTEN, 1922—Charlottenberg, Germany: Zementverlag. Paper; 6 x 9 in.; pp. 200; illustrated.

RAILWAYS AND HARBORS, UNION OF SOUTH AFRICA: Report of General Manager, 1921-22. Pretoria. Paper; 8 x 13 in.; pp. 190; map, diagrams and half tones.

RAILWAY STATISTICS OF THE UNITED STATES OF AMERICA, 1921: Compared with the Official Reports for 1919 and Recent Statistics of Foreign Railways—Prepared by Slason Thompson, Bureau of Railway News and Statistics, Chicago, Ill. Paper; 6 x 9 in.; pp. 143.

RECOMMENDED MINIMUM REQUIREMENTS FOR SMALL DWELLING CONSTRUCTION: Report of Building Code Committee, United States Department of Commerce. Washington, D. C.: Department of Commerce. Paper; 6 x 9 in.; pp. 108; line cuts. 15c. from Superintendent of Documents.

RESEARCH IN HIGHWAY EDUCATION—By William Kendrick Hatt, Director Advisory Board on Highway Research, National Research Council, 1701 Massachusetts Ave., Washington, D. C. Reprinted from Proceedings of Second National Highway Conference.

TEST OF A HOLLOW TILE AND CONCRETE FLOOR SLAB REINFORCED IN TWO DIRECTIONS—By W. A. Slater, Engineer Physicist, Bureau of Standards, Arthur Hagener, Engineer, and G. P. Authes, Engineer Whiteacre Engineering Co. Paper; 7 x 10 in.; pp. 727-93. 25c from Superintendent of Documents, Washington, D. C.

VALUATION OF PUBLIC SERVICE UTILITIES IN THE STATE OF WASHINGTON—By John H Fletcher, C. E., Valuation Engineer, Olympia, Wash. Paper; 4 x 6 in.; pp. 56.

Outlines valuation fundamentals; summarizes valuations made in Washington and 1920 incomes of utility companies in that state; analyzes the purchase by Seattle of the local street railways there. The pamphlet is primarily for investors.

YEAR BOOK OF THE CITY MANAGER'S ASSOCIATION—Paper; 6 x 9 in.; pp. 264. 55c.

Contains Proceedings of 1922 convention and tabulation of city manager data.

Letters to the Editor

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

Closes Discussion on Highway Location

Sir—Please allow me a brief rebuttal on the subject "Does highway engineering call for locating skill?"

Mr. Quackenbush estimates that less than 5 per cent of the mileage requires railroad methods, and that of this 5 per cent probably a large extent is controlled by politicians. If that is the case, we must leave more than 95 per cent out of this discussion, for the reason that a mere traverse of an existing road for the purpose of improving it has little to do with l cating. He grants that a railroad locater, however, with proper consideration of the needs of a highway will likely do a better job.

Mr. Lavis thinks that the technique of surveys can be benefited by a study of railroad location, but that fundamental principles are different and cites steep grades and sharp curves as an example. Our answer is that the principles seem to be different but taking into account the same tractive effort and resistance why should they be different?

In relation also to the matter of grade, Mr. Patterson says that a pedestrian takes the short but steep trail, yet a cow takes the long but easy path. Although time is no object to a cow, there is another reason; she carries more freight than a pedestrian. As our highways begin to carry more freight our highway officials will regret the steep grades and short distances. In the early days our railroads used momentum grades. As they became able they eliminated them to an extent and jacked up the track; but with a concrete pavement down on these undulating grades, as they are styled by highway engineers, it will be a sorry job to use our concrete slabs as "relayers" when the grade is bettered. The turnouts for highways have their analogy in passing sidings.

Mr. Myers thinks that highway location calls into more attention a flexibility not allowed in railroad location. Which can exceed its rated horsepower under duty the more, a locomotive or a gasoline motor? A horse has the poorest rated horsepower, as it can exert under stress considerably more than its normal capacity. A steam engine comes next, a gasoline motor next and an electric motor last; and a highway locater is or should be restricted to maximum grades and curvature as would be a railroad locater. Understand me, the rules should be the same although the maximums are different in all cases. A politician's house to be served is as truly a controlling point as a river crossing and it will take equal skill to get the best line to either.

Now with regard to the fact that highways are built not for profit but for public service. Cogitate this a little. A dollar saved is a dollar earned; why should one need less skill than the other? The question will answer itself.

Mr. Tinsley also mentions the stiffer grades and sharper curves used by highway engineers. We admit that there is a difference in "degree" but no difference required in "skill."

Mr. Rader says he has located railroads ten years without first locating a railroad. I think, however, he must have used the railroad handbooks of Searles, Nagle, Allen, Webb, or possibly read Wellington. Where can you get a book dealing with location that does not apply to railroads? Sometimes a railroad is prone to sustained grades, sometimes not equally so a highway.

Nearly all writers including Mr. Gillette think that the undulating grade makes the highway a different proposition. If you were comparing a first-class railroad with a second-class highway, or vice versa, it could be said that the results were different but it is yet to be proved that the principles are different after studying Prof. Agg's experiments.

To summarize: (1) Curvature and grade offer the same resistance to tractive effort on highways as on railways; (2) Rise and fall and virtual grades affect locomotion or traction the same, comparing car with car or train with train; (3) Compensation for curvature is equally important; (4) Superelevation for railways has its counterpart in banking of highway curves; (5) Controlling points are limitations either on railways or highways. Where an improvement follows the old route, for example, the whole line is controlled and limited.

R. S. BLINN.

Sparta, N. C., Jan. 23.

Another Pile Bearing Formula

Sir—To R. C. Norris, Civil Engineer, Muar, Johore, Straits Settlements, I am indebted for copies of his booklet of forty pages, entitled "Formula for Pile Driving, with Examples, Detailed Explanations and Test Records. A Reliable and Entirely New Method." Singapore, 1922.

Mr. Norris takes account *separately* (1) of the "Resistance (R_D) to *driving*," and (2) of the "grip" (G_P) or *additional* resistance due to the *re-compacting*, around the pile, of the soil which was disturbed by the driving.

For the resistance, R_D, in pounds, to *driving*, Mr. Norris uses the formula:

$$R_D = C\frac{W \times v}{S+1} + M = C\frac{W\sqrt{2gh}}{S+1} + M = C\frac{8\sqrt{h}\,W}{S+1} + m\,(W+w);$$

where

C = a coefficient (ranging from 0.7 to 0.9) intended to cover losses of energy in fall of ram;

h = height of final fall of ram, in feet;

W = weight of ram, in pounds; w = weight of pile, in pounds;

$v = \sqrt{2\,g\,h} = 8\sqrt{h}$ = theoretical velocity of ram at instant of its striking the pile-head;

S = penetration or "set" of pile, in inches, under last blow before rest;

g = gravity acceleration = 32 ft. per sec. per sec.;

m = a coefficient ranging from + 1.1, for S = 26 in., to — 3.5 for S = 0.1 in. When S = 2 in., m = zero.

Mr. Norris's method of treating the additional resistance, due to "grip" (somewhat simplified) may be illustrated as follows:

At Perth Amboy, N. J., in 1875 (see Trans. Am. Soc. C. E., 1892, August, pp. 148 and 153) four piles, in a square, were driven L = 33 to 35 ft. into "pretty fair mud"; W = 1,700 lb.; h = 25 ft.; S = 2 in. By means of a platform, the four piles were loaded with 80 "long" tons (179,200 lb.), giving an average resistance, R_L, to *loading*, of 44,800 lb. per pile, under which all but the largest pile (18 inches diameter at top) had settled; maximum settlement = 3 in.

Since, in this case, S = 2 in., we have m = 0; and Mr. Norris's formula for resistance to driving, with C taken at 0.85 gives

$$R_D = 0.85 \times \frac{8 \times \sqrt{25} \times 1{,}700}{3} = 19{,}266 \text{ lb.}$$

Taking R_L = 44,800 pounds, we have

"Grip," G_P, for entire pile, = $R_L - R_D$ = 44,800 − 19,266 = 25,534 lb.

Number, n, of 10-ft. lengths in the driven length, L = 33/10 = 3.3;

"Grip," G, per 10-ft. length of driven pile = G_P/n = 25,534/3.3 = 7,737 lb.;

K = resistance, R_D, to driving, per ten-foot length of driven pile, = R_D/n = 19,266/3.3 = 5,838 lb.;

G/K = 7,737/5,838 = 1.33.

In other words, in this case, we find the "grip" = 1.33 × the resistance to driving.

Mr. Norris assumes K_S = 7,000 lb. per driven 10-ft. length of a 12 in. pile, in "pretty fair clay" (S = 2 in.), as a "standard" value of K.

Then, for a corresponding "standard" value, G_S, of G, we should have:

$G_S = (G/K)\ K_S = 1.33 \times 7{,}000 = G\ (K_S/K) = 1.2 \times 7{,}737 = 9{,}310$ lb. per driven foot-length of pile.

Conversely, for the Perth Amboy piles, we should have:

$G = G_S\ (K/K_S) = 9{,}310\ (5{,}838/7{,}000) = 7{,}737$ pounds per ten-foot driven length;

$$G_P = \frac{L}{10} G = \frac{33}{10} \times 7{,}737 = 25{,}534 \text{ lb.; and}$$

$R_L = R_D + G_P = 19{,}226 + 25{,}534 =$ say 44,800 lb., as above.

Mr. Norris adopts the following standard values of K_S, G_S and S_S:

	For wooden piles, 12 in. diam.			For concrete piles, 14 in. square		
	K_S	G_S	S_S	K_S	G_S	S_S
Pretty fair clay	7,000	8,300	2.0	3,000	2,820	1.75
Stiff clay	10,000	22,340	1.5	3,000	4,200	1.00

In the following comparison, R_N is the extreme load on one pile, calculated by Mr. Norris by means of his formula; and R_L is the actual static load causing settlement, as nearly as it can be gathered. See Trans. Am. Soc. C. E., 1892, August, pp. 148-155.

	R_N	R_L	R_N/R_L
1. Aquia Creek	19,415	13,333	1.46
	19,798	13,333	1.48
3. Mississippi	27,100	33,600	0.81
4. Perth Amboy	44,394	44,800	0.99
5. Fort Delaware	36,748	40,000	0.92
7. Buffalo	90,000	75,000	1.20
...Muar, concrete pile, 14 in. square	20,109	20,160	1.00

The two Aquia Creek cases, above quoted, were selected from a list of twelve cases. Mr. Norris takes weight, w, of pile $= 56 \times 40 = 2{,}240$, which appears excessive. Taking $w = 1{,}000$, I obtain $R_N/R_L = 1.14$ and 1.09 respectively, in place of his 1.46 and 1.48. With $w = 1{,}000$, I obtain, for the other ten Aquia Creek cases, $R_N/R_L = 1.20$, 1.43, 1.11, 1.00, 1.44, 1.22, 1.12, 1.17, 1.49 and 1.46 respectively.

Having found the extreme resistance, R_L, to loading, in any case, by his formula, Mr. Norris uses a safety factor ranging from 0.5 to 0.7, according to the circumstances of the case.

JOHN C. TRAUTWINE, JR.

Philadelphia, Pa., Feb. 6.

Stresses in Arch Dams

Sir—In your issue of Jan. 18, 1923, p. 131, Lars Jorgensen takes issue with some of my statements regarding deflections and stresses in arch dams.

A theoretical investigation of the deflections of the Salmon Creek Dam in Alaska indicates that according to standard formulas, tension stresses of over 2,000 lb. per square inch would have to exist in order to permit the dam to deflect elastically as much as was actually measured. Such high tension stresses in concrete are obviously impossible, and the natural conclusion is that the concrete has cracked under excessive strain.

Mr. Jorgensen admits that the vertical construction joints open up under the influence of low temperatures and the shrinkage of concrete. This fact illustrates in a striking manner that the standard bridge-arch theory can with equal correctness be applied to arch dams.

In view of this it is reasonable to assume that the simple cantilever theory is equally applicable for the vertical sections of arch dams. Inasmuch as the theoretical cantilever stresses in many arch dams are very much in excess of the ultimate tensile strength of concrete, it must be concluded that horizontal cracks exist in these structures.

Experience has shown that apparently neither vertical nor horizontal cracks endanger seriously the stability of such a dam under ordinary conditions. However, open cracks in an unreinforced concrete structure are very undesirable, and should be avoided, if possible, by improved methods of design.

An investigation of arch and multiple arch dams is being made by a committee of engineers under the auspices of the Engineering Foundation. The deflections and stresses, temperature changes, etc., will be measured on a number of arch and multiple-arch dams already built, and also on specially constructed test dams. It is hoped that such tests may lead to improvements in the design and construction of future dams.

An arch dam designed scientifically for combined cantilever and arch action was recently constructed on the river La Jogne in Switzerland. The deflection measurements during the first season seem to indicate that theory and practice agree very well.

In order to obtain harmonious action between vertical cantilever and horizontal arches, the span of an arch at crest should not be more than 2 to 2½ times the height of the dam. For damsites of greater width, horizontal and vertical cracks in the dam are liable to occur. For this reason, in certain European countries, notably in Italy and Sweden, multiple-arch dams are being constructed in preference to single arch dams. The investigations of the leading hydraulic engineers of those countries clearly indicated the superiority of the multiple arch type of dams which combines the advantages of gravity and arch dams without involving certain undesirable features inherent in those two types.

FRED A. NOETZLI.

San Francisco, Calif., Feb. 1, 1923.

Remedy Suggested for Low Road-Bids

Sir—An editorial in the *Engineering News-Record*, Jan. 11, 1923, p. 52, calls attention to the low bidding on road work during the year 1922 and assigns a possible reason. It further goes on to state that contractors should organize and be more on a business basis.

What is meant by organization? Does it mean that a few contractors should gather together, write a constitution and by-laws, elect officers, collect dues, air their views and intercede here and there in the interest of members? It is admitted that such an organization will do some good, but will it put contracting on a safe business basis? Will it prevent work being bid under cost or at too low a figure to return a reasonable profit? If so, how?

What is usually accomplished by an organization such as we speak of in other lines of business? For instance, the tobacco pool, blue-grass-seed pool, hemp-seed pool, brick association, cement association, sand and gravel association, hardwood manufacturers association, etc.? Isn't it true that the articles manufactured by the members of these various concerns have a market value, fixed by the producers so as to return a profit?

Why not perfect a practical organization? Let all contractors in a state join an association, list their equipment, organization and financial status so that it can be determined with a great deal of certainty what class and what amount of work each contractor is capable of doing during a season. Select from their number men to go over each piece of work that is to be let, analyze the cost of each item, add a reasonable profit and submit a bid under the name of the association.

If any outsiders desire to bid, let them do so as usual.

The state road department should make detailed estimates of the cost of doing each unit of work and it would be a very easy matter to determine if the association is submitting reasonable bids. If the work is awarded to the association it is in turn assigned to the contractors best fitted to build that particular type of road. Through such an arrangement every contractor's equipment and organization could be kept busy at work at the greatest efficiency.

The state road department, in addition to a bond, would have the assurance that the work would be properly organized, proper equipment would be used and that the work would be completed on time, and should there be need of completing any section in a rush it could be done very easily.

Such an organization would be a practical one, a legitimate one and contractors would be allowed to make a reasonable profit and contracting would be placed on a business basis that would be recognized by all financial institutions. There is not any organized opposition to the price of cement, brick, lumber, sand and gravel, crushed stone, gasoline, bread, hair cut, price of room in a hotel, price of tobacco, cigars, cigarettes, and in fact practically every known commodity used by man today.

Then why not permit a contractor to make a reasonable profit and allow him a business standing.

Winchester, Ky., Jan. 16, 1923. RODMAN WILEY.

Would Avoid Adjectives in Engineer Titles

Sir—Without special regard to the term "sales engineer," the writer would be glad to see the use of such expressions as "sanitary engineer," "concrete engineer," "bridge engineer," "sewer engineer," and the like—when employed, of course, as titles for the practising engineer and not as designations of a particular professional class—discontinued for all time. A much more dignified usage would be "engineer of bridges," "engineer of sanitation," "engineer of concrete construction," or "engineer in charge of such and such branch of work" as the case may be.

The writer remembers being discouraged by a prominent contractor from taking up the practice of sanitary engineering at graduation, his argument being directed against the title "sanitary engineer" and not of course against the professional practice. In another instance the chief of an important department of a large railroad company refused to be designated by the title "bridge engineer" and insisted in correspondence that he be addressed as "engineer of bridges" at all times. The abridged titles that have been enumerated doubtless were originated with intent to emphasize by the shortest route certain special knowledge possessed by the holder. Too often, however, the effect is opposite to that intended, and one may assume that the professional outlook of the engineer in question may be quite restricted. These points are for the most part merely formal, but the writer believes that they should be emphasized and insisted upon by those who have the dignity and advancement of the engineering profession at heart.

Ames, Iowa, J. H. GRIFFITH.
Jan. 24.

Suggested Relocation of Automobile Headlights

Sir—The regulation of automobile headlights is one of the biggest problems that traffic officers will have to solve. It is always a nervous strain to drive at night on even a moderately traveled road, because there is a glare from the lights of every passing car, even though they have special lenses; and nowadays it seems to be considered a disgrace ever to change to dimmers when passing. At a speed of 25 or 30 miles an hour, which will be reasonable upon our improved roads, there must be good illumination for 100 to 150 ft. in front of a car in order to allow time for stopping in case of an obstruction.

The present headlights are placed at a height of only 2½ or 3 ft. from the ground, with the result that some of the light rays must be almost horizontal if they are to illuminate the road for any distance ahead. However, since the rays can be concentrated to as small an area as desired, why not point the lamps downward, and concentrate them so that the center of the beam would strike the road 100 or 150 ft. away, with the top of the beam striking about 200 ft. away? There would then be no rays pointing straight ahead to blind an approaching driver, and the road would get the full effect of the lights.

But it would be still better to place two smaller lights, one of them movable, at the upper corners of the windshield, incorporating them in the general design of the car, and doing away with the lower headlights. They would be 5 or 6 ft. from the ground instead of 2½ or 3 ft. thus affording better illumination of the road and less possibility of glare ahead, and with one of them movable, like the very useful spotlight, they would give every service desired of a headlight, and at the same time there would be none of the glare and discomfort which are caused by headlights as they are now placed.

This would be a somewhat radical design, as headlights have had their present position since automobiles were first designed (one of the reasons, perhaps, why they are unsatisfactory today), and it might require some change in the design of the windshield and its bracing; but the problem would be easy compared to most problems that have been solved by automobile designers. The change in the appearance of the car would not be nearly so noticeable as has been caused in the past by changes in design. Objections such as these would not count if the lights accomplished their purpose of eliminating the dangerous glare.

These suggestions might not solve the headlighting problem completely, but if they were carried out they would make night driving much more pleasant and very much safer, and it is certain that some change will have to be made soon in the headlight laws if accidents at night are to be prevented.

JOHN C. ALLMAN,
Resident Engineer,
Illinois Division of Highways.
Carbondale, Ill., Jan. 19, 1923.

Reaction Against Road Expenditures

Sir—In *Engineering News-Record*, Nov. 23, 1922, p. 886, the editorial entitled "Reaction against highway expenditures" has been, to me, very interesting as it is an answer, in part, to a question which has been frequently asked in the last few years, "How far will the public go in its expenditures for improved highways." Although this review does not answer this question wholly and a complete answer to the question is impossible at the present time, nevertheless it does answer in so far as it shows that a large part of the people have reached that point where they are beginning to ask the question and the very fact of their so doing is proof that if the peak of construction has not been reached or is not in sight, at least such construction is going to be examined from the point of practical need rather than impractical desire.

Some years ago the construction of improved highways was a county proposition. Then it became a state proposition although largely controlled by the county unit. Today it is an interstate and nation-wide proposition yet controlled to some extent by the county unit.

It seems to me that you might well have added a seventh "line" to your table at the bottom of the second column, which would have read something as follows:

7. Ignorant and unjust criticism of the public or taxable units by state highway officials.

It sometimes seems as if the fact that public works are carried on with moneys obtained by taxation and that taxes are paid by the public and levied and collected by and through the authorized political agents (authorized agents or representatives frequently derogatorily spoken of as "the politicians"), is overlooked. That the very life blood which permits the highway departments to grow and function, is furnished by bodies of men who are honored by being chosen to govern us, and in the next breath we dishonor them by sneeringly calling them politicians when to be a politician by the first definition of the word is one of the most honorable professions in the world.

Might I suggest one other "line" to be added to the above mentioned table at the bottom of p. 888 as follows:

8. Learn the first definition of the word politician as given in Webster's Unabridged Dictionary and teach it and practice it whenever possible.

This article in the *Engineering News-Record* is primarily an article to officials and employees of State Highway Departments but the *News-Record* is not read only by these men but frequently gets into the daily papers through quotation and thereby your statements become matters of public reading and interest. It is not necessary for me to go into a detailed explanation of the following suggestion and the reasons therefore. Therefore I will only suggest that there also be added one more "line" to the aforementioned table as follows:

9. That public officials in dealing with highway situations in their respective states or districts do not publicly condemn the entire system or department upon the acts of one official or the condition of one piece of road a few miles in length.

"Keep the public sold on highways" but keep them sold by honest representation of the product and welcome honest and intelligent criticism as earnestly as you oppose dishonest and ignorant criticism.

T. M. RIPLEY.
Hornell, N. Y., Jan. 18, 1923.

News of the Week

CURRENT EVENTS IN THE CIVIL ENGINEERING AND CONTRACTING FIELDS

Director Roberts Resigns in Cleveland

Mayor's Retrenchment Campaign Turns To Arbitrary Meddling With Water Department

Staff Correspondence

On Feb. 5 Arthur B. Roberts, formerly a member of the consulting engineering firm of Withington-Roberts-Wright Co., and during the past year Director of Public Utilities of the City of Cleveland, resigned from the city service, together with his first assistant, George W. Kneisly, as the result of personal antagonism developing between them and Mayor Kohler through the mayor's interference with the operation of the water department, which was in Mr. Roberts charge. The resignation is the outcome of long-continued turmoil and progressive disorganization in the technical and other departments of the city government initiated by the mayor during the past year in execution of his purpose to economize in the cost of running the city government. Previous events in this reorganization so far as the technical departments are concerned, were the dismemberment of the technical staff of the sewage-disposal branch, the death of the assistant chemist through an accident due to his having to undertake unfamiliar duties, reduction of the operating force at the sewage and water purification plants, salary reductions, and other items of reorganization in the service and utilities departments.

Expenditures Exceed Income

Municipal expenditures in Cleveland for several years past have exceeded the city income, and during the past half dozen years Cleveland has accumulated a bond indebtedness between $5,000,000 and $10,000,000 on account of running expenses. The Kohler administration, beginning with 1922, undertook to reform this condition by sharp curtailment of expenditures, including reduction of force and of salaries in various departments, the virtual abolition of the force of the Park Department, and the like. As a result, it was recently announced by the mayor, the city lived within its income during 1922. The reorganization and retrenchment measures, however, are said to have been unwise and not merely ineffective but harmful in a number of instances, and in their later developments to have jeopardized the efficiency of the city's technical work in vital manner. They were applied in dictatorial and offensive manner and aroused resentment among the department heads.

Political factors are also claimed to be involved. The preferential voting system instituted in Cleveland at the last election destroyed local machine control and enabled Kohler, former chief of police and later dismissed on charges, to carry the election. It is charged that the methods used in the administration during the past year have in part been due to a desire to develop political dictatorship. A further factor in the matter is that with the beginning of 1924, city manager government will be instituted.

Chief among the points of contention that led to the resignation of Director Roberts were the demand of the mayor that the engagement of J. W. Ellms as consulting engineer of water purification be terminated, that contracts for auxiliary works at the Baldwin reservoir and filtration plant be awarded to the general contractor for that plant, and that the offices of the Water Department be rearranged to suit the mayor's ideas. A contract had just been awarded by the Water Department for a special-brick chimney at the filtration plant, to cost $12,000, and the award of this contract to an independent contractor was a special object of the mayor's attack, who demanded that the general contractor's bricklayers should build the chimney. Mr. Ellms has been in advisory charge of the operation of the water filtration plants since 1916, with liberty to carry on outside work. A year ago the city entered into a contract for his half-time services in directing the filter plant operation, to cover 1922 and 1923. The mayor roundly declares that "Ellms is no good" and that he is not worth 50 cents a day, and has ordered the city treasurer to hold up his pay.

Last Headings on Shandaken Tunnel Holed Through

The last pair of headings on the Shandaken tunnel of the Catskill aqueduct for New York City's water supply were holed through at 3 a.m. Feb. 13, between Shafts 2 and 3. This event marks the opening up of a continuous stretch of 18¼ miles of tunnel for the delivery of water into the Ashokan reservoir.

Thaddeus Merriman is chief engineer and the Shandaken Tunnel Corp. (Ulen Contracting Corp.) is the contractor.

Louisville Company May Get Ohio Power Rights

Washington Correspondence

Judging from arguments presented at a hearing before the Federal Power Commission and by the apparent attitude of Secretary Weeks, its chairman, it is presumed that ultimately an award for power rights at the Falls of the Ohio River will be made to the Louisville Hydro-Electric Co. The city of Louisville is contesting the company's argument to be granted such power rights. Arguments for the Louisville Hydro-Electric Co. are based on the fact that it already has in operation a new unit which will furnish an additional 30,000 hp. With this installation it is in a position to make the best use of the variable power to be developed at the dam, it was contended.

Michigan Engineers' Society Gets Public Contact

Meeting Augmented by Industrial Show—Legislation and Deep Waterway Symposium

Engineering News-Record Staff Report

Muskegon, Mich., knows a convention of professional engineers was held there Feb. 7, 8 and 9, if the record-breaking attendance of laymen at an engineer's meeting is any criterion. At a Rotary Club luncheon, at a Kiwanis Club luncheon, at the society's annual banquet and dance, at the industrial exhibition, where 34 firms showed the tools, works and equipment of the engineer, and at the civic banquet in the Elks Temple attended by nearly five hundred representative people of the city, the members of the Michigan Engineering Society, which is the state division of the American Association of Engineers composed of eleven chapters, obtained a contact with the citizen seldom experienced. Chapter achievements, drainage legislation, building-code operation, waste disposal, stream pollution and resort sanitation, lowering the lake levels by the Chicago drainage canal and an extended symposium on the Great Lake-St. Lawrence deep waterway were features of the program.

Chapter Activities

In the symposium on chapter activities Port Huron, Saginaw, Pontiac, Lansing, Detroit, Ann Harbor, Flint and Muskegon were reported in a flourishing condition, handling local civic activities and making the engineer's influence felt as a citizen. Muskegon was awarded first honors because of the opportunity it afforded the society of an unexampled contact with the public. Grand Rapids is just emerging from a struggle with constitutional difficulties in working out an amicable arrangement with the local club of 150 members. Battle Creek is a new chapter. Cadillac did not report.

Thanks to the official publication the society has recently climbed out of debt and expects soon to put the secretary, C. B. Huff, back on a full-time basis. He reported 65 new members, 21 resignations and 70 dropped (most of whom had left the state) and 50 per cent of his time given over to the service department. The state organization wants less money spent on national conventions by concentration of representation from other states. This plan is exemplified by Michigan when only three delegates are sent from the eleven chapters. The Salt Lake convention cost about $1 per member.

In the newly-adopted constitution and by-laws explicit support is given to the engineers license law and the Board of Examiners. Two cases of violations are under consideration by the board.

In the symposium on the Great Lakes-St. Lawrence waterway six papers and an introduction giving the present status of the problem were presented. Gardner S. Williams, in reviewing the situation, indicated favorable sentiment

from the North Central states, those in the Northwest and West and in western Canada, with New England favorable by a small margin. The South and Pacific States are indifferent. Active opposition centers in New York with support from Atlantic Coast shipping and railroads east of the Mississippi River. Before the papers are printed, Mr. Williams, who has charge of the symposium, hopes to have investigated a government-built railroad of four tracks from the Middle West to the Coast over which the railroads would be allowed to run their trains without charge. Private rather than federal financing of the St. Lawrence project seems the more likely at present.

The following contributions to the symposium were made: F. C. Shenehon, vice-president, H. M. Byllesby & Co., gave fundamental physical and hydrographic data, and stressed the inevitability of the development. Henry Holgate, consulting engineering, Montreal, asserted that improvement of present waterways to 22-ft. depths is the next step in navigation, further improvement not being imperative now. Herbert C. Sadler, professor of marine engineering and naval architecture, University of Michigan, was of the same opinion as Mr. Holgate as to ocean liners sticking to the ocean. From 60 to 70 per cent of the vessels of the world could use a 25-ft. channel and 70 to 90 per cent if it were 30 ft. M. G. Barnes, chief engineer, division of waterways, Illinois, made a plea for the development of the Mississippi pending the completion of the St. Lawrence project. Lewis M. Haupt, consulting engineer, Cynwyd, Pa., answered the layman's objections with reviews of former projects. A paper by Hugh L. Cooper, consulting engineer, New York, on the power development presented a year ago before the American Institute of Electrical Engineers, will be included in the symposium which the society will print and distribute.

Sanitary Engineering

Of the sanitary engineering subjects, S. A. Greeley, consulting engineer, Chicago, in discussing garbage problems stressed the point that the unfortunately large record of failures in refuse collection and disposal warrants much greater attention to the engineering details in the development of the various projects. Major E. D. Rich, state sanitary engineer, outlined the comparatively new methods of collection at Lansing, where city-owned flared cans, easy to nest, are washed in boiling water at the piggery 5 miles from town before return to the householder.

E. F. Badger, chemical engineer, State Department of Health, spoke on the nuisance and injurious effects of concentrated industrial wastes on fish life. So badly polluted have some rivers become that the department recently ordered six cities to prepare plans for treatment of wastes. Resort sanitation came in for an extended discussion with an account of the work done by the motorized laboratory as described in *Engineering News-Record*, Sept. 14, 1922, p. 430.

J. G. D. Mack, state engineer of Wisconsin, outlined the status of the lawsuit between Wisconsin and the Sanitary District of Chicago over the lowered lake levels due to alleged unlawful withdrawal of water beyond the 4,167 sec.-ft. permitted by the government. Mr. Mack stated that the governor had sent him to Michigan to learn whether Michigan was interested.

Prof. Clarence T. Johnson, University of Michigan, gave the fundamental considerations in an ideal drainage law on which the society's legislative committee (H. L. Hudson, consulting engineer, Highland Park) and the County Drain Commissioners Association are at work.

Newly-elected officers of the society are as follows: President, James R. Rumsey; vice-president, C. E. Wood; treasurer, H. A. Shuptrine; and L. E. Ayres, director-at-large.

Six-Year Index

To make the contents of past volumes available quickly *Engineering News-Record* has compiled a complete, classified index of articles published during the period 1917-1922, inclusive, beginning with the first issue of the journal formed by the consolidation of *Engineering News* and *Engineering Record* on April 5, 1917.

The index will be published in March. It has been prepared solely as a service to readers. The edition is limited but while the supply lasts will be sold for $3. With each order for the 1917-1922 index will be sent free one of the 1910-1917 indexes of *Engineering News*, a limited supply of which is on hand.

Orders for the index should be sent in immediately, addressed to: "Index Editor, Engineering News-Record, 10th Ave. at 36th St., New York, N. Y."

Kansas Engineers Favor Uniform Traffic Regulations

Highway construction and traffic regulation were prominent features of the annual meeting of the Kansas Engineering Society, held at Topeka, Kan., Dec. 14 and 15. Resolutions were adopted urging adoption by the state legislature of regulations covering the weight, speed and size of motor vehicles; also laws governing traffic regulation, such laws to apply uniformly throughout the state and to conform to those of other states. In view of increasing motor vehicle traffic the Society also favored a continuance of federal aid and a state system of highways in compliance with the federal-aid law. Papers presented included the following: "Economical Floor Systems and Reinforcement of Steel Bridges," Ira E. Taylor; "Drainage and Flood Protection in Kansas," Clark E. Jacoby; "Use of Tractors in Road Construction and Maintenance," L. E. Curfman; "Quality of Concrete for Highways," Roy A. Seaton; "Problems of the Engineering Profession," Lloyd B. Smith. The officers for 1923 include the following: President, P. L. Brockway, city engineer of Wichita; vice-president, L.E. Curfman, State Normal College, Pittsburg, Kan,· secretary, C. P. Buck, vice-president of the Perfection Metal Products Co., Topeka, Kan.; new member of executive committee, F. W. Epps, bridge engineer of the State Highway Department. The next meeting will be held at Wichita, Kan., but the date was not decided.

New York Road Builders Face Big Year

Meet at Annual Banquet and Discuss Problems Looming as Result of Heavy State Program

Engineering News-Record Staff Report

On the eve of his leaving the office of state highway commissioner, Herbert S. Sisson was the guest of the New York State Road Builders' Association at its sixteenth annual banquet held in Albany on Feb. 7. The incoming commissioner, Col. Frederick S. Greene, whose appointment had been confirmed only that day, was expected also, but he was unexpectedly called from the city.

Commissioner Sisson acknowledged the co-operation accorded to him by the contractors engaged on the state road work, and emphasized the advantage derived by the state from having its highway construction in the hands of contractors working under conditions that insure them a reasonable profit. He reminded those who would have public officials run their offices as they would "their own business" that should any official attempt such a departure he soon would find himself either removed from office or in jail. Mr. Sisson extended his best wishes to his successor.

John H. Gordon of Albany, president of the association, presided. Other speakers were, T. Warren Allen, former state commissioner and now in federal aid work; H. K. Bishop, also with the Federal Aid Bureau in Washington; Guy Miller, district engineer on federal aid projects in the Eastern states; William Hill, president, Pennsylvania Highway Builders' Association, and Fred E. Ellis, president, Massachusetts Road Builders' Association and a trustee of the New York Association.

All dealt constructively with the problems that confront the highway construction industry, including labor shortage, rising costs and the need for closer co-operation between contractors, engineers, commissioners, and the manufacturers of materials and equipment. Mr. Ellis pointed out especially that the contractor is necessarily in the position of a "short seller" who, every time he takes a contract, must sell that which he does not then own and which he must create in future markets.

Portland Engineer To Build Willamette River Bridges

R. E. Kremers, principal assistant city engineer, of Portland, Ore., and who has also been bridge engineer and chief of the bureau of construction in that city, has been appointed by the Multonomah County commissioners to direct the work of building the Burnside and Ross Island bridges on the Willamette River for which $3,000,000 and $1,600,000 respectively were voted last November. The work will be under the jurisdiction of the Board of County Commissioners, although the City of Portland contributes to the extent of about 93 per cent of the Multonomah County taxes.

The contract under which the work is to be carried on had not been officially signed on Feb. 3, but it was expected at that time that the contract would be entered into very soon.

New Jersey Highway Commission Nominated by Silzer

Following the passage by the New Jersey legislature on Feb. 13 of the new law creating a bipartisan state highway commission of four members, Governor Silzer has sent the following nominations to the Senate: General Hugh L. Scott of Princeton, republican, two years; Percy Hamilton Stewart of Plainfield, democrat, two years; Walter Kidde of Montclair, republican, four years; and Abraham Jelin of New Brunswick, democrat, four years.

Mr. Jelin's public life, according to the executive's statement, has been limited to holding the office of street commissioner in New Brunswick from 1910 to 1913 and that of assessor there since 1915. He is a real estate operator and contractor and said to be thoroughly acquainted with road building.

Mr. Kidde is an engineer and president of Walter Kidde & Co., of New York. He also heads the Barlow Foundry of Newark and is a director of the Street & Apparatus Co. of New York, and other corporations.

Mr. Stewart is a former mayor of Plainfield and in 1919 was appointed by Governor Walter E. Edge to the State Board of Education. He was renamed by Governor Edwards in 1920.

General Scott is known not only for his long service in the United States Army but for his work among the Indians in the West. He was Chief of Staff in 1917 when he retired, but was recalled to the service and placed in command at Camp Dix until May, 1919. He has had wide experience in the building of roads in Cuba, the Philippines and the United States.

Organize Regulating District for Upper Hudson

Pursuant to the river regulation section of the state conservation law, the Water Control Commission of New York state has, upon the petition of several interested communities, established a regulating district for the watershed of the Hudson River, extending from its headwaters to the vicinity of Ravena, about twelve miles below Albany. In addition to that city, the district includes Troy, Watervliet, Cohoes, Glens Falls and other important communities. The board of the regulating district, appointed by the governor, consists of Henry M. Sage, president; Edgar H. Betts and Erskine C. Rogers. Ranulf Compton has been appointed secretary-treasurer and E. H. Sargent engineer to the board.

River regulating districts in New York state are created, according to the terms of the conservation law, for the construction, maintenance and operation of reservoirs to regulate the flow of streams when required by the public welfare, including public health and safety. The districts are public corporations, having among other powers, that to exercise the right of eminent domain, to issue bonds and to levy assessments and taxes upon properties that are benefited by the regulation works. The Black River Regulating District has already been established under this law.

Technical Society Booklets Ready for Distribution

Engineering News-Record has prepared for free distribution booklets containing essential information on about 300 national, state, district and local technical societies. Data in the booklets contain the names of the president and secretary of each society, the date of the annual meeting and the approximate membership. The booklets may be had by addressing "Editorial Department, Engineering News-Record, McGraw-Hill Co., 10th Ave. at 36th St., New York City."

Public Roads Bureau Approves Perth Amboy Bridge Plans

Plans for the new Perth Amboy bridge across the Raritan River, in New Jersey, have been approved by the U. S. Bureau of Public Roads. This bridge, to be constructed by New Jersey with Federal aid, at an estimated cost of $3,000,000, will carry the traffic from the metropolitan district of New York to the south, a large part of which is bound for Philadelphia and New Jersey coast resorts. The structure is to replace one constructed in 1906 which is no longer adequate in width of roadway or strength to carry modern traffic. The new bridge will consist of 1,089 ft. concrete viaduct, 1,538 ft. of steel plate girders, a 360-ft. swing draw, and 5,490 ft. of earth fill approaches. The roadway will be 38 ft. wide to accommodate four lines of traffic with sidewalks on each side. Construction will be commenced during the coming season.

Frank Page Nominated as Road Builder's President

Frank Page, chairman of the State Highway Commission of North Carolina, has been nominated by the nominating committee of the American Road Builders' Association as president for the 1923-24 year. Other nominations include: For vice-president, E. L. Powers, W. F. Keller, S. F. Beatty, and Samuel Hill; for treasurer, James H. MacDonald; for directors, one-year term, J. R. Draney, W. A. Van Duzer, and Frank Sheets; for directors, two-year term, E. J. Mehren, I. W. Patterson, William R. Smith, H. K. Bishop, J. H. Cranford, C. M. Babcock, and H. S. Carpenter; and for directors, three-year term, S. T. Henry, R. Keith Compton, Fred A. Reimer, Charles M. Upham, H. G. Shirley, Will P. Blair, and Frank Terrace.

Conference on Interstate Highway Co-operation Is Pinchot Plan

Invitations to the governors of all states have been issued by Governor Pinchot of Pennsylvania to send representatives to a highway conference at Harrisburg, Pa., on March 23 and 24. The purpose of the conference will be to consider the policy and practice of state highway construction, methods of state highway maintenance and the whole problem of traffic regulation.

News Brevities

The next convention of the American Society for Municipal Improvements will be held at Memphis, Tenn., Nov. 12-16. Charles C. Brown, St. Petersburg, Fla., is secretary, and W. W. Horner, St. Louis, Mo., president of the society.

Headquarters of the Canadian National Railways are to be established in Montreal. This decision ends speculation rife during recent months as to whether the roads would be administered from Ottawa, Toronto or Montreal.

Amalgamation of the Grand Trunk Ry. with the Canadian National Railways has ended the individual existence of the former road, which for more than sixty years has been one of the chief transportation systems of the Dominion.

The American Association of State Highway Officials has opened general offices in Washington, D. C., in the Munsey Building. W. C. Markham, former legislative expert with the Bureau of Public Roads, is in charge. His title is that of executive secretary.

At the recent annual meeting of the American Institute of Consulting Engineers C. W. Leavitt, New York City, was elected president, and Allen Hazen was elected vice-president. Col. F. A. Molitor continues as secretary.

A bill was introduced into the New York Legislature last week, by Assemblyman Vaughn, by which the New York State Bridge and Tunnel Commission is empowered to investigate the desirability of a bridge or tunnel between Tottenville, Richmond County, and Perth Amboy, N. J., for pedestrians and vehicular traffic.

The Washington Committee on Public Utility Information has been formed with offices in the Henry Building, Seattle, and E. H. Thomas, director of the committee. The committee is backed by private light and power companies of the state, and interurban electric lines. The purpose of the bureau is to promote better relations between the utilities and their customers, and to give the public such utility information as it may desire.

Special Rule Sought for Navy Contractors' Relief Bill

Having reported with amendments a bill for the relief of contractors and material men who had fixed-price contracts with the Navy Department during the war and suffered loss through priority orders, wage awards or other directions of a governmental agency, the House committee on naval affairs will ask a special rule for the consideration of this measure before adjournment of the present session of Congress.

A bill of this character has been before one or the other branch of Congress for nearly three years without coming to a vote. The present bill recommended by the House committee is that which was passed by the Senate nearly a year ago, although amendments have been made by committee.

St. Louis Votes $87,372,000 Bonds for Municipal Improvements

By popular majorities exceeding the necessary two-thirds the voters of St. Louis, Mo., on Feb. 9, approved 20 out of 21 items for sewerage, water-works, paving, buildings, and other municipal improvements. The approved items total $87,372,000. The item defeated was $1,000,000 for a National Guard Armory.

The items voted on were arranged on the ballot in an apparently haphazard fashion, numbered from 1 to 21. In the accompanying table showing the 20 items that carried, the items have been classified by main objects and the totals under each class supplied.

The total number of votes cast was approximately 90,000 against a registration of about 275,000 (including women) at the election last November. The highest vote cast for any one item was 77,170 for $12,000,000 of water-works enlargements, the negative vote being 12,325. Next to this was 77,162 for $4,500,000 of hospital additions, but here the adverse vote was higher, being 12,905. The least popular project, besides the defeated National Guard Armory, was the small item of $400,000 for an aquarium in Forest Park, which carried by a vote of 62,633, to 27,919. The $6,000,000 item for a memorial plaza and hall had next to the lowest majority, the vote being 64,080 to 25,789.

ST. LOUIS BOND ISSUES AUTHORIZED AT ELECTION ON FEB. 9

No.			
6	River Des Peres Improvement (sewerage)	$11,000,000	
5	Sewer construction	8,000,000	
			$19,000,000
	Buildings, including in some cases sites and equipments:		
13	Municipal auditorium and community center	5,000,000	
12	Additions to hospitals	4,500,000	
5	New court house and site	4,000,000	
20	Reconstruction public markets	1,250,000	
11	Municipal power and service building, including machine shop, garage, and laundry for municipal requirements	1,000,000	
15	Fire engine houses and equipment	772,500	
10	Aquarium	400,000	
			17,922,500
1	Street opening and widening (city's share)	8,650,000	
3	Paving, repaving and improving streets	5,800,000	
			14,450,000
21	Water-works enlargements:		
	Missouri River plant, including pumping station, pumps, etc.	5,100,000	
	Conduits and right-of-way	1,977,500	
	Reservoir	1,150,000	
	Distributing mains	2,740,000	
	Contingencies	1,032,500	
			12,000,000
4	Street lighting equipment		8,000,000
	Municipal plaza and buildings		6,000,000
8	New public parks, playgrounds, recreation fields and swimming pools—Land buildings, etc.	2,500,000	
9	Improvements to old public parks, etc.	1,300,000	
			3,800,000
17 & 18	Approaches (railway) to Municipal Bridge		3,000,000
2	Union Station plaza		2,600,000
16	Grade crossing elimination—city's share		1,600,000
Item 19, $1,000,000 for National Guard Armory, defeated.			$87,372,500

Five-Year Construction Plan for Bluefield, W. Va.

A five-year municipal improvement plan for Bluefield, W. Va., with a series of tables exhibiting the plan in detail, showing how it might be financed and how it would affect the tax rate year by year, has been submitted to the city directors by Clarence C. Ridley, city manager. The plan provides for a total expenditure of $750,000, of which over $400,000 is for sewers, about $150,000 for paving, $100,000 for parks and playgrounds, and the remainder for buildings and minor work. A topographical survey of the city has been made and consulting engineers are working on plans for a comprehensive sewerage system.

Transportation Survey to Be Made in New England

Washington Correspondence

Much importance is attached, at the Bureau of Public Roads, to the transportation study which is to be made in New England by the Joint New England Railroad Committee. This survey is to cover railroad, highway and waterway transportation, with the idea of developing methods for their correlation.

The executive committee, which will direct the work, is headed by James J. Storrow, of Boston. Other members are James F. Dewey, representing Vermont; George L. Crooker, Rhode Island; E. Kent Hubbard, Connecticut; Carl E. Milliken, Maine, and Lester F. Thurber, New Hampshire. A. B. Fletcher has been brought on from California to take immediate charge of the study of highway transportation.

National Museum of Engineering and Industry Planned

A joint committee on a national museum of engineering and industry appointed by the four Founder Societies is formulating a plan for a national museum of engineering and industry with a large central institution and local branches in different sections of the country, with exchange facilities.

This museum for the United States will be similar in plan and educational purposes to the Science Museum, London, and the Conservatoire des Arts et Metiers, Paris, but will be on a larger scale.

The project has the co-operation of the Smithsonian Institution in Washington, D. C., and will be developed with the assistance of the Federated American Engineering Societies.

The members of the Joint Committee are: Edward D. Adams and Charles L. Clarke of the American Institute of Electrical Engineers; Frederic A. Delano and Dr. George F. Kunz of the American Institute of Mining and Metallurgical Engineers; Clemens Herschel and Nelson P. Lewis of the American Society of Civil Engineers; and Reginald P. Bolton and Holbrook F. Porter of the American Society of Mechanical Engineers.

Steel Unit Stresses Discussed

Arguments in favor of analytical study of the factors which should determine working stresses in steel structures were expressed in a discussion of the subject before the structural subsection of the New York Section, American Society of Civil Engineers, on Jan. 31. Several speakers took the view that increase in working stresses for steel in building service requires no study of safety factors but is justified by the improvement in steel manufacture since the days when the present 16,000-lb. unit stress first came into use. A rather different view was taken by others, who advocated high unit stresses on the basis of making full provision for each of the attacking forces and other service elements, providing in each for the contingencies that may affect it, rather than providing for these contingencies in a reduced unit stress. Thus, the chance of increase of load is to be provided for in the assumed loading rather than in a lowered unit stress. The question of whether the effective ultimate strength of steel is the elastic limit or a higher value was also discussed, with some disagreement of opinion. The opposite cases of transmission towers and steam turbine foundations were cited as instances of the failure of ordinary considerations governing unit stresses. Transmission towers are frequently designed for working stresses equal to the yield point of the material, a practice which is successful because of the small chance of overload and the economic necessity of light design. Turbine foundations, on the other hand, are always designed with very low unit stresses, because rigidity is an essential and foundations designed for normal unit stresses have been found to lack rigidity. Some attention was also given to the subject of making special allowance (of thickness) for corrosion. However, a case was cited of the beams in the concrete floor of the ice cream room of a restaurant, which on alteration of the building were found to be almost entirely gone, illustrating that in many cases corrosion must be prevented by waterproofing or other protection rather than allowed for by extra metal.

To Survey Traffic Needs Between Los Angeles and Harbor

Richard Sachse, chief engineer, California Railroad Commission, will serve as chairman of a joint committee which is to conduct a study of transportation developments between the City of Los Angeles and the harbor at San Pedro. Other members of the committee are H. Z. Osborne, chief engineer, Board of Public Utilities, and J. W. Ludlow, harbor engineer of Los Angeles. The joint action was agreed upon after the city council had passed a resolution calling for a report that would give "careful consideration to the proposition of obtaining a unified railroad system between the city and the harbor, either under municipal control or private control, as the interests of the public may demand, having in mind all dangerous grade crossings now existing and speedy and adequate movement of freight to and from the harbor. In view of the magnitude of this problem the conclusions are to be returned at as early a date as possible."

Engineering Societies

Calendar

Annual Meetings

AMERICAN RAILWAY ENGINEERING ASSOCIATION, Chicago; Annual Convention, Chicago, March 13-15.

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Annual Convention, Norfolk, Va., May 7-9.

AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia; Annual Meeting, Atlantic City, N. J., June 25-29 or 30.

American Waterworks Association, Canadian Section will have its annual convention at Toronto, Feb. 22 and 23. C. D. Brown, Walkerville, Ont., is secretary.

The Boston Society of Civil Engineers in its meeting February 21, will have a "Symposium on City Pavements."

The Engineers Society of Pennsylvania will give a smoker Feb. 17, in honor of Governor Pinchot, who has long been a member of the society.

Personal Notes

E. H. SARGENT, formerly in charge of the Bureau of Water Power in the State Engineer's department of New York state, and engineer for the New York Water Power Commission, has been appointed engineer for the Hudson River Regulating District, with headquarters at Albany.

H. G. PERRING has resigned as chief engineer of Baltimore to become supervising engineer of the Public Improvement Commission, which is charged with the responsibility of disbursement of the $55,000,000 loan for public improvements in the city of Baltimore, including the school building program, covering the expenditure of $22,000,000.

SANDERS & SWEENY, consulting engineers of Anderson, S. C., have dissolved partnership. F. R. SWEENY, of the above firm, has organized a new engineering firm under the name of F. R. Sweeny & Co., to enter into a practice of civil, mechanical, electrical and industrial engineering, paying particular attention to textile engineering.

NEWTON A. K. BUGBEE, secretary-treasurer of the Newton A. K. Bugbee Company, engineers, of Trenton, N. J., has been re-elected State Comptroller of New Jersey by a joint session of the Legislature for a three year term. Mr. Bugbee has held the office for several years.

CLOYD M. CHAPMAN has become affiliated with Dwight P. Robinson & Co., Inc., as consulting materials engineer. Mr. Chapman, who has been active in the work of the American Society of Testing Materials and the American Concrete Institute, will in the future represent Dwight P. Robinson & Co. in the societies' committee work.

FREYN, BRASSERT & CO. have been engaged as consulting engineers by the Columbia Steel Corp. of San Francisco for the construction of a new blast furnace plant at Provo, Utah.

FRANK A. RANDALL, formerly of Berlin, Swern & Randall, Chicago, announces that he will continue independently the practice of structural engineering in Chicago.

H. N. RODENBAUGH, chief engineer of the Florida East Coast Ry., has been appointed general manager of the road, succeeding the late J. F. BECKWITH.

EARL WHEELER has become vice-president of the Roger Black Company, Inc., engineering and construction, New York City. Colonel Wheeler was formerly director of electrical and mechanical engineering of the Engineer School, U. S. Army, and for several years local manager of the General Electric Co.'s sales office at Washington. During the war Mr. Wheeler was successively a major and a lieutenant-colonel, connected with the procurement and distribution of engineer supplies. Later he was in charge of the engineering and purchasing department, responsible for all specifications, purchases and contracts, in addition to production; and still later, in charge of the general engineer depot at Washington. Since the war Colonel Wheeler has been engaged on engineering and financial promotion of foreign trade and public utility projects.

Dr. THOMAS STOCKHAM BAKER, who for the past eight months has been acting president of Carnegie Institute of Technology, was recently elected president of the Institute. Dr. Baker succeeds Dr. A. A. Hamerschlag, who was president of Carnegie for almost 20 years. Dr. Baker has been secretary of Carnegie Tech since March, 1919. He is a graduate of Johns Hopkins University with an A.B. degree in 1891 and a Ph.D. in 1895. From 1895 to 1900 he was associate in German language and literature at Johns Hopkins and from 1900 to 1908, professor of German. In 1909 he became director of the Jacob Tome Institute at Port Deposit, Md., where he remained for ten years, leaving to accept the secretaryship at Carnegie.

EUGENE J. RIGHTS, for the past 14 years erection engineer for Lewis F. Shoemaker & Co. and the Shoemaker Bridge Co., has been appointed professor of civil engineering at the University of Porto Rico, Mayaguey, P. R. Among the difficult erection jobs handled by Mr. Rights were the wet dock crane for the American International Shipbuilding Corp., at Hog Island, Philadelphia, and the Newburyport Bridge for the Boston & Maine R.R., which was described in *Engineering News-Record* of Dec. 7, 1922.

ALBERT A. NACK has resigned as building inspector for the city of Sheboygan, Wis., and will engage in the contracting and engineering business in that city.

THEODORE B. PARKER, formerly assistant hydraulic engineer for the Electric Bond & Share Co., and, prior to that position with the Utah Power & Light Co., has entered the hydraulic division of Stone & Webster, Inc., of Boston, Mass.

M. H. CUTLER, formerly of the Turner Construction Co., and the Morrison Skinner Co., has entered the organization of Stone & Webster, Inc., Boston, Mass., as an engineer in the structural division.

THEODORE B. MOODEY, civil engineer of Greeley, Colo., has been appointed county highway and bridge engineer for Weld County, Colo., relieving John Wortham, resigned.

W. S. DAWLEY, formerly chief engineer of the Chicago & Eastern Illinois R.R., and also the Missouri & North Arkansas Ry., has assumed an interest in the McKelvey Construction Co., St. Louis, Mo. During the war Mr. Dawley served the United States Railroad Administration as field engineer for the southwest region.

EDGAR A. KINGSLEY, who has been a consulting engineer at Little Rock, Ark., has joined the organization of Benham Engineering Co., Kansas City, Mo., and will be located in Oklahoma City, Okla.

Obituary

LE GRAND BROWN, deputy chief engineer of Rochester, N. Y., since 1919, and for many years identified with railway work in upper New York, died in Rochester, Feb. 8, aged 60 years. Mr. Brown began his professional career with what is now the Rome, Watertown & Ogdensburg R.R. in 1882. From 1884 to 1885 he was in Florida on land surveying and railroad location. Returning to Rochester he aided in the location of the Rochester branch of the Lehigh Valley R.R. In 1890 he was made chief engineer of the Rochester R.R. From 1891 to 1895 he was employed in engineering and construction work with the Rochester Water Works. Later he became engineer for the Rochester Ry., still later going to California to do consulting work.

H. J. SEAMAN, one of the pioneers in the portland cement industry and for many years general superintendent of the Atlas Portland Cement Co., died at his home in Ventnor, N. J., on Feb. 9 at the age of 64 years. Mr. Seaman was the co-inventor with E. H. Hurry of the famous Hurry-Seaman process of rotary kiln manufacture of portland cement.

HARRY R. RUST, contractor, Philadelphia, Pa., died suddenly Jan. 21, aged 56 years. He was born in Bedford, England, but came to this country at an early age. In 38 years in the contracting business in Philadelphia he had built many large commercial buildings and plants as well as school buildings.

BERNARD E. FERNOW, who in 1886 was made first chief forester of the United States, died recently in Toronto, Can., at the age of 73 years. In 1898 he became dean of the school of forestry at Cornell and later was professor of forestry at other universities of this country and Canada, at the time of his death being professor emeritus of Forestry at the University of Toronto.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

More Suggestions—

For Better Equipment and Repair Parts Service

IN the Dec. 14 issue was begun a discussion of "Better Equipment Maintenance and Repair Parts Service," which has continued during succeeding weeks. Its object is to show how some of the misunderstandings between maker and user of construction machinery can be avoided. This week's contribution is a recital of experiences by a manufacturer of conveying and crushing machinery and electric locomotives.

From the Jeffrey Manufacturing Co., Columbus, Ohio

BEFORE a manufacturer can fill a repair order he must have sufficient description of the part to be furnished properly to identify it. Simply to give a name does not help much and oftentimes adds confusion. Therefore, the first information necessary is the class of machinery, as parts of the same name are used on different classes of machines.

Next, the type of machine is required, for different types are gotten out to meet the different conditions in the field. As long as there is progress and development in machinery, just so long will new models be brought out, so that it is necessary to know the model. As there may be more than one size of the model or variations, these should also be noted.

In order to make all this more simple each machine is given a serial number or, if it is an installation of equipment which is more or less special for a particular job, it is given an order or job number which will identify it as that particular installation. This serial or job number should always be given in ordering repair parts.

Different parts of like name are often built into the same piece of apparatus, so that having located the record of the machine, one is at a loss to know just which bearing, gear or shaft, etc., is required. Sufficient description should be given to identify each particular part wanted.

Use Parts Numbers

Catalogs, lists of parts or blue prints are always furnished the customer. These should be preserved and referred to when ordering. The part number given therein should be used. This will insure receiving the correct material and will save considerable time in looking up work after the order has been received by the manufacturer. This, in turn, will permit quicker delivery on the order. If a parts catalog is not at hand, then a full description should be given. For example, if a shaft is being

(Continued on p. 325)

Commerce Department to Help Study Lumber Industry

Washington Correspondence

An important step forward in the campaign looking to the elimination of waste in industry is about to be made. Plans are practically complete for a survey of the lumber industry with the idea of developing the wastes which can be eliminated profitably. Waste cannot be eliminated, to an important extent, by legislation. If it is to be prevented, it must be made profitable. The contemplated investigation will be made under a co-operative agreement between the Department of Commerce and the lumber industry and the plan is to extend this form of co-operation rapidly to other industries. It is believed that a systematic and nation-wide study of wastes, by industries, will reveal many practical opportunities for the utilization of byproducts.

Associated Equipment Distributors Elect Officers

At its annual meeting in Milwaukee, Jan. 12-13, the Associated Equipment Distributors elected the following officers for 1923:

K. B. Noble, the K. B. Noble Co., Hartford, Conn., president; E. D. Townsend, Beckwith Machinery Co., Pittsburgh, first vice-president; William Bunting, Bunting Hardware Co., Kansas City, Mo., second vice-president; W. B. Louer, W. B. Louer Co., Chicago, treasurer; M. R. Hunter, Hunter Machinery Co., Milwaukee, secretary.

The foregoing officers, together with the following additional members, will constitute the new executive committee: F. B. Connelly, Billings, Mont.; R. H. Hyland, Chicago; D. M. Edgerly, Omaha; J. A. McDivit, Baltimore; George F. Smith, St. Louis; M. S. Seibert, Columbus; and William H. Ziegler, Minneapolis.

Italian Garbage Process Ready for Use in U. S.

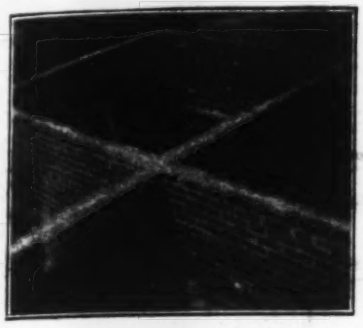
New American Company Organized to Introduce Beccari System, Producing Fertilizer Byproduct

A GARBAGE disposal process of Italian origin, which produces by natural fermentation in a special type of aerated cell, a dry, inert mass possessing value as a fertilizer, is being introduced in the United States by the American Beccari Corp., New York City, a newly formed organization, headed by J. Waldo Smith, consulting engineer and formerly chief engineer of the New York Board of Water Supply which built the Catskill aqueduct. Associated with him are other well-known engineers, including Jules Breuchaud, vice-president of the new company and president of the Underpinning & Foundation Co., Inc.; James F. Sanborn, secretary, former department engineer on the Catskill aqueduct; John B. Goldsborough, general manager and Francis Pruyn, vice-president of the Underpinning & Foundation Co., and E. Payson Cooke, general manager. The corporation has been operating for several months an experimental plant in Paterson, N. J., although large-scale installations have been in service for some time in both large and small cities of Italy, including Florence, Naples, Genoa, Milan and Turin.

ONE OF THE BECCARI GARBAGE DISPOSAL PLANTS IN OPERATION IN ITALY

Charge is introduced through openings in roof and removed after conversion to fertilizer humus through lower doors; view shows ventilating towers.

The process has been developed by Dr. Giuseppe Beccari, Italian scientist and inventor, and is designed to handle garbage only—not mixed refuse. In the Beccari process the fermentation of organic matter in the garbage takes place in covered masonry cells, each about 10 ft. high and 8 x 9 ft. in plan, built generally in groups of four, and charged through openings in the roof. Liquids are drained off and a supply of air introduced through a slotted false bottom or grating with outlet connection to a sewer and air inlet ports. Extending horizontally around the inside of each cell are four continuous curbs or baffles projecting a couple of inches from the surface of the wall and spaced about 2 ft. apart. In each corner of the cell is a vertical air passage. The upper part of the chamber communicates with a tower several feet high



FOUR-CELL UNIT AT PATERSON, N. J.
Construction view of experimental plant showing corner air ducts and horizontal curbs around chamber.

containing four horizontal shelves or baffles on which are placed layers of absorbent earth and sulphate of iron, whose function is to fix the volatile products (nitrogen and ammonia) carried upward by the air current.

It is essential in the functioning of the process that air comes in contact with the garbage. The charge is introduced into the cell through an opening in the roof, after which air, entering through the ports under the false bottom, passes upward through the grating and corner air ducts and along the channels formed beneath the projecting curbs above referred to. The air leaves the chamber through the ventilating tower at the top. One of these towers serves a four-cell unit.

The garbage is allowed to remain in the cell from 35 to 40 days. The fermentation raises the temperature of the material to about 150 deg. F., during which chemical and bacterial action reduces the mass to the form of a dry, inoffensive humus, which is removed through doors in the bottom and disposed of as fertilizer.

Each cell may be charged with about 24 cu.yd. of garbage and the engineers of the Beccari company estimate that for a high-class residential community plant capacity may be figured on a basis of one cell per 1,000 population.

Advocates of this method of garbage disposal make the following claims for it: It creates no nuisance; it is extremely simple and cheap in operation having no mechanism or moving parts; it is a flexible system of units and as such is suitable for both large and small scale installations; it creates no dust, smoke or gases; it lends itself to locations at many points within a city thus reducing haulage; it produces a fertilizer the sale of which reduces cost of operation.

Construction Equipment Exported

According to figures given out by the U. S. Department of Commerce exports of power shovels and other types of construction equipment for November, 1922 were as follows: Nine power shovels valued at $127,953; dredging machinery totaling 193,090 lb. valued at $16,678; 9 cranes at $28,566; and 318 hoists and derricks value at $95,748.

Three of the power shovels, costing $32,387 went to Japan and two each to Rumania ($26,180) and Spain ($21,675). Egypt took one power shovel at $45,031. Brazil was the biggest consumer of dredging machinery, with shipments totaling 145,816 lb. Latin-America was the leading purchaser of cranes during November.

Equipment and Repair Parts

(*Continued from p. 324.*)

ordered, the kind of metal, diameter, length, and size and position of keyways should be mentioned, together with any other additional information which may be necessary.

If a gear or sprocket is being ordered, the following should be noted: Kind of material; spur or bevel gear, or pinion; number of teeth; pitch diameter and pitch; face, bore, length and size of hub; keyseating dimensions, and size and number of set screw, if wanted. If there are any numbers or letters stamped on or cast into the parts wanted, it will be well to give them.

If the description cannot be made clear in writing the order, then a sketch should be drawn showing all dimensions and sent with the order. If it is not convenient or practical to make a sketch and it is possible to send a sample, this should be done.

Changed Equipment

If parts are ordered to change the equipment already installed the manufacturer should be notified so that he can change his records. This should be done regardless of whether the parts necessary to make the change are ordered from the original manufacturer of the equipment or not—that is, if you ever expect to order replacements from the original manufacturer—so that his records can be kept complete and up-to-date as to your requirements.

A customer desiring to make a change in his equipment sent in an order for some sprockets and chain which, on the face of the order, had all the indications of being a repair order. The description was insufficient to tell just what was wanted. A careful checking of previous orders showed that material resembling the description had never been furnished and it seemed evident that the customer had made a mistake. This was explained to him in a letter. He immediately replied that he knew what he wanted, had given sufficient information and directed this company to send on the material. He never mentioned the fact that a change was being made. There was but one of two things left to do—turn down the order, or make a guess. The guess was made that the customer was making a change and the material that would be required was shipped. The guess proved correct in this case. However, considerable time could have been saved both to the customer and manufacturer if the customer had been specific.

When second-hand or used machinery is purchased, the manufacturer should be notified and list of parts and other information necessary to the correct ordering of repairs should be obtained.

Shipping Directions

Shipping directions must also be noted carefully. First, as to the way shipment is to be made—freight, express or parcel post—and, second, as to destination. Express companies refuse to receive shipments addressed to points where they do not have offices unless the shipment is addressed "Put off at owner's risk" at the station without an office. This fact is often overlooked, so that the shippers must choose the point with an office without having all of the information at hand. Local conditions often change, but these changes cannot be noted in a shipping guide which is only gotten out at stated intervals.

The Equipment Problem

From the report of the Committee on Methods presented at the annual convention of the Associated General Contractors in Los Angeles, Calif., Jan. 30-Feb. 3.

The development of construction equipment has progressed in the past with very little contact between the manufacturers and users of construction machines, and the breach between the two agencies has precluded many advantages to both parties that are obtainable through their joint study of the contractor's equipment needs. The contractor, on one hand, has felt at times that the equipment manufacturer tried to see how many different kinds of bolts and nuts he could incorporate into his machines and, on the other hand, the manufacturer has felt that the contractor was the most non-cooperative being in existence. This attitude is rapidly disappearing, however, and your Association has established a joint committee with leading equipment manufacturers to serve as a medium in bringing these two interests together and overcoming their difficulties through joint action.

At a joint meeting held in Detroit last October, which was attended by some 40 representatives of well-known equipment companies, a committee of 15 contractors and equipment manufacturers was appointed to investigate some 15 different subjects of mutual interest. The committee is to formulate recommendations concerning matters of business transactions that are capable of immediate determination, and to continue investigation of standardization and other matters that require more extensive deliberation.

The manufacturer has shown a hearty spirit of cooperation and your committee believes that continuation of the work of this joint committee will result in many benefits to construction companies in both their field operations and in the business end of construction.

Another question which is just as important as the specifying of material is the ordering of material on time. Do you wait until you are up against it or do you allow sufficient time to permit the manufacturer to get the material to you? This is especially important where material has to be made up. Every factory must have a certain amount of work on hand to operate economically. Orders must take their rotation through the shops. Rush orders always disturb the schedule. This means an increase in the cost of production and delay on other orders. Even if emergency orders are shipped from stock there is always more or less delay because of transportation.

It would, therefore, seem best for customers to make a careful inspection of all equipment at necessary intervals, note parts which are showing wear and which will require replacement in a short time, and order these parts at once. Note should be made, also, of parts that are apt to break and extras should be kept on hand as insurance.

Avoid "Rush" Orders

Many lines of business are seasonal. Machines should be gotten in repair before the rush season is on. Yet this is often not done and consequently many orders are placed within a short space of time and immediate delivery cannot be made on all such orders.

You may say, "Why doesn't the

manufacturer prepare for this rush season?" He does, but his estimates may be off in some cases.

A number of similar machines may have been installed. During a slack period part of them have been robbed to keep the others going. These machines should be put in repair and arrangements made for the necessary material far enough ahead so that the manufacturer will have sufficient time to get the necessary parts out.

One of our customers had a number of machines. In order to keep a few going during a slack period, he robbed the others until nearly all of them were out of commission. He did not order parts until the rush season was on and then demanded that he be furnished sufficient parts on an emergency basis to put all of his equipment back into service. The only possible way this could have been done would have been to upset schedules and rob other orders, which would not have been fair to other customers who had ordered on time.

IDLE MACHINES NEED CARE

Machinery should be properly taken care of and protected when idle. Many parts are permitted to rust and corrode when not in use, requiring immediate replacement when operation is resumed.

During a recent slack period many users left their electrical equipment in damp places which permitted the armatures and field coils to become saturated with moisture and caused the resistance to rust out. The motors were then started up under load without properly drying them, which resulted in short circuits and blow-outs. This created an abnormal demand on the above-mentioned items, far beyond the manufacturer's estimate, so that new supplies had to be arranged for with the consequent delays.

When it is found that some parts are showing excessive wear or breaking too frequently, a careful inspection should be made to discover the cause. If this cannot be determined, a service man should be called in to get at the seat of the trouble.

The manufacturer realizes that his future depends upon the service he is now giving and is putting forth every effort to render that service, but there are many instances where he is put under a tremendous handicap by his customers. The right understanding of each other's position and a willingness to co-operate would materially help the manufacturer render the kind of service demanded by the customer.

(To Be Continued Next Week with Experiences of the Blaw-Knox Co., Pittsburgh)

Court Denies Infringement of Waterproofing Patent

In an order issued Dec. 16, 1922, Judge Julian W. Mack, sitting in the United States District Court in New York City, entered an order dismissing a suit for infringement of patent brought by Arthur B. Harrison against Gardiner & Lewis, Inc., in the matter of United States Patent No. 1,347,095 for waterproof fabric and process for producing the same. The plaintiff is the manufacturer of Minwax waterproofing materials and the defendant produces Karnak, a waterproof fabric.

Business Notes

WALWORTH MANUFACTURING CO., Boston, maker of pipe, valves, fittings and tools for steam, gas and water supply service, acquired Feb. 1 the business and property of the Hiram Rivitz Co. of Cleveland, Ohio, which will be operated as a subsidiary of the parent organization under the name, Walworth Ohio Co. S. R. Mitchell becomes vice-president and general manager of the new Walworth unit at Cleveland. The Rivitz property includes a modern warehouse and pipe shop, a large pipe storehouse, and the service station, all in Cleveland, in addition to the warehouse and store in Youngstown. The Ohio company will take over from the parent organization its western division, including territory in Ohio and Western Pennsylvania. At the Cleveland warehouse will be maintained complete stocks of valves, fittings and tools for steam, gas and water supply. With the exception of its president, who retires from the field, the Rivitz organization will be maintained.

BLAW-KNOX CO., Pittsburgh, has purchased 19 acres of river frontage at Blawnox, Pa. This tract, asquired from the T. A. Gillespie Co., adjoins the company's present works and will be used for expanding plant facilities, according to Albert C. Lehman, president. The company is now working 100 per cent capacity and is handling a number of contracts from the Texas Co., American Sheet & Tin Plate Co., Milwaukee Electric Railway & Light Co., contracts in connection with the construction of the Welland canal, Canada, and also a large volume of construction for Japan.

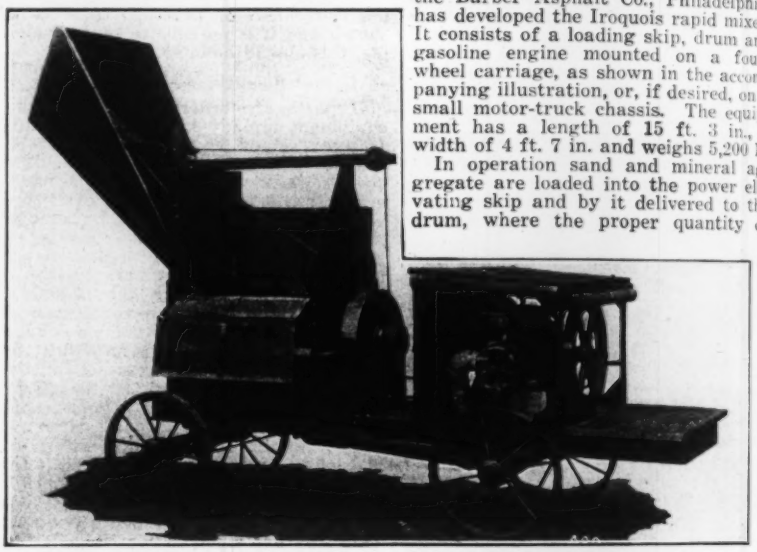
WALLACE & TIERNAN CO., INC., Newark, N. J., re-established on Jan. 2 an office in New York City to keep in closer touch with its customers in the metropolitan district. The new office is in the Woolworth Building and is in charge of Alan M. E. Johnstone.

DRAVO EQUIPMENT CO. has been organized to represent manufacturers of contractors and road building equipment in Pittsburgh, Chicago, Cleveland, New York and Philadelphia. The company will carry stocks in all these cities and will have service facilities. The general sales office is temporarily located at 1,100 Diamond Bank Building, Pittsburgh.

Equipment and Materials

Portable Hot-Mix Plant for Bituminous Pavement Repairs

To supply a demand for a small, inexpensive, portable plant for producing hot bituminous paving repair mixtures, the Barber Asphalt Co., Philadelphia, has developed the Iroquois rapid mixer. It consists of a loading skip, drum and gasoline engine mounted on a four-wheel carriage, as shown in the accompanying illustration, or, if desired, on a small motor-truck chassis. The equipment has a length of 15 ft. 3 in., a width of 4 ft. 7 in. and weighs 5,200 lb.



In operation sand and mineral aggregate are loaded into the power elevating skip and by it delivered to the drum, where the proper quantity of Genasco liquid asphalt is added. While the agitating blades of the drum are revolving 2 pints of gasoline are introduced into the drum and lighted. The mixing process is then continued for 6 min., at the end of which time the flame has died out and 4 cu.ft. of hot asphalt mixture are ready to spread.

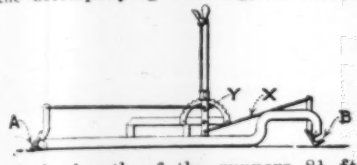
This mixing process is patented in conjunction with the use of Genasco liquid asphalt, which provides a material that, when flashed, burns until the lighter factions are driven off, leaving a hot asphaltic mixture at a temperature of from 250 to 350° F. The material, the manufacturers claim, is not coked by this process when properly used.

Supplementary equipment for the rapid mixer includes tampers, smoothers, asphalt shovels, rakes, cutters, and push broom. A 5-ton roller also is recommended, although satisfactory compression may be obtained by the use of a 1,000-lb. hand-roller with a compression of 50 lb. per square inch. The equipment described is recommended by its maker for contractors having bituminous pavement under guarantee where the repair yardage is not sufficient to warrant economical operation of a standard asphalt plant. It is also designed for use by cities and townships, traction companies with responsibility for pavement maintenance between car tracks and for maintenance of state highways.

Road Maintenance Drag Has Adjustable Blades

Designed as an improvement over the ordinary earth road drag the Austin-Western Road Machinery Co., Chicago, has placed upon the market a "Planetainer" with adjustable front and rear steel blades, each 8 ft. long.

The weight of the device, shown in the accompanying drawing, is 450 lb.

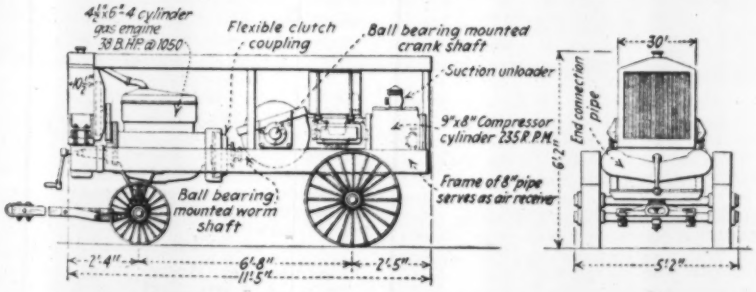


and the length of the runners 8½ ft. The equipment is designed for operation with a tractor or roller. Among the advantages claimed for this equipment is that the long runners, traveling over a surface planed smooth by the front blade, prevent either blade from dropping down into and digging out low spots in the road. However, by adjusting the angle of the blades, all of the weight may be concentrated upon them, or, if desired, upon the runners. In all 18 variations in adjustment are possible by means of the notched and lever arm. The relation of blade A and B may be reversed by fastening rod X in hole Y.

Pipe Frame for Compressor Serves as Air Receiver

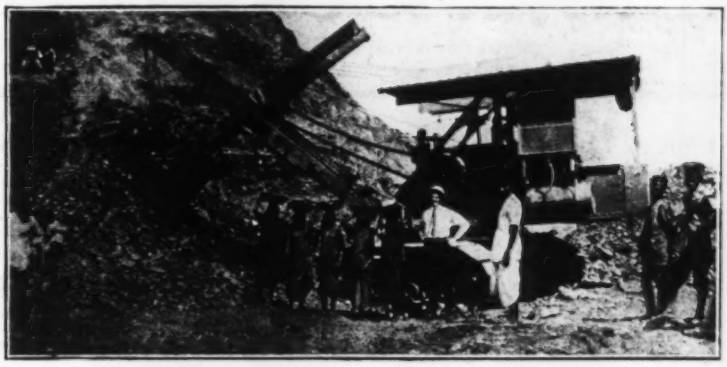
In the design of one of its latest types of Traylor portable compressors, the Cement Gun Co., Allentown, Pa., has introduced a novel feature by making the bearing frame of 8 in. pipe to serve the double purpose of supporting the weight of the equipment and acting as an air receiver. The pipe frame is connected with a cast steel head and air is inletted at one end of the pipe and outletted at the other, thereby insuring large receiver capacity and cooling area. The equipment is mounted on four steel-tired wheels and weighs 6,500 lb.

The compressor is of the horizontal type, slow speed, with 9 in. cylinder and 8 in. stroke, power being furnished by



a 4½ x 6 in. four-cylinder Buda gasoline engine. The rig delivers 100 cu.ft. of free air per minute at 100 lb. per sq.in. pressure. A small pump bolted to the side of the frame supplies water under pressure to the jackets of the compressor, or may be used in connection with the cement gun or other work where water is required.

The outfit can be furnished with electric drive and mounted on either metal wheels or rubber tired automobile wheels, springs and axles.



American Power Shovel Demonstrated in India

Primitive and modern methods of excavation and material handling were the subject of a recent demonstration on the Worli Road near Bombay, India, in which a gasoline-driven power shovel made by the Pawling & Harnischfeger Co., Milwaukee, was operated before a group of engineers representing the local railroad companies, public works department, the Sukkur barrage, the Sutley irrigation project, and the Sardha canal.

After the machine had operated as a power shovel the boom was removed and replaced with a dragline attachment with which a sewer trench was excavated. Earth-handling methods ordinarily employed by native labor consist of scooping up the material by hand into containers which are carried, often by women, on the top of the head, as shown in the picture.

The Pawling & Harnischfeger Co. is introducing its excavating machinery in the Far East and believes that the power shovel and dragline have a particular application in India, where a drainage and flood control work.

Publications from the Construction Industry

Locomotive Repairs by Welding—METAL & THERMIT CORP., New York, has issued the fourth edition of its Thermit locomotive pamphlet (67 pp., illustrated) intended for railroad superintendents of motive power, general foreman, blacksmith foreman and Thermit welders. Chief among the revisions in this edition are instructions for applying improvements in practice in Thermit welding which have been developed by research. The drawings and instructions illustrating and describing welds in various parts of locomotive frames and other locomotive and railroad equipment have been completely revised since the publication of the previous edition.

Manhole Castings—WILLIAM E. DEE Co., Chicago, is distributing a 51-p. illustrated catalog of its manhole and gutter castings. Among them is a reversible manhole curb, which is claimed to be lighter and more economical than the one-piece castings, and the D. & D. safety and noiseless manhole cover which rests on lugs instead of the old style ledge in the frame, doing away with jarring and rattling. The support is not on the top of the lugs but on the sides inclined at 45 deg., so that wedging action is produced. A wide variety of solid and slotted covers are illustrated for manholes and catch-basins.

Concrete Floor Forms—NATIONAL CONCRETE METAL FORMS CORP., New York, in a 20-p. illustrated pamphlet, offers instructions for framing the D & R system of forms for concrete floors. The forms are of No. 16 gage metal, in 3-ft. lengths, and are removable after the concrete has set. Steps in setting up and removing the forms are described in detail for the benefit of construction foremen and there are tables indicating the quantities of form lumber required per 1,000 sq.ft. of decking and per 100 lin.ft. of shoring.

Centrifugal Pumps—DE LAVAL STEAM TURBINE Co., Trenton, N. J., describes small single-stage centrifugal pumps for motor or belt drive in a leaflet and in an instruction manual just issued. These pumps are made in 1½ and 2 in. sizes, and are designed for capacities ranging from 5 gal. per minute against 10 ft. head up to 130 gal. per minute against 150 ft. head. They contain few and simple parts, which are manufactured to limit gages to insure interchangeability. The publications give tables and instructions for selecting pumps for different conditions and explain how to determine the proper speeds and how to select piping, valves, fittings, and driving pulley or motor to secure an efficient and satisfactory installation.

Business Side of Construction

FACTS AND EVENTS THAT AFFECT COST AND VOLUME

Trend of Business Indicates Increased Activities

According To National City Bank Of New York All Domestic Conditions Give Promise For A Good Year

The National City Bank of New York in its survey of general business conditions at the outset of the year, makes the following report:

"The trend of business in the first month of 1923 has been very satisfactory. There is no slackening of industry, and all domestic conditions give promise for a good year. Industry is about as active as it was ever known to be or can be with the present labor supply. The steel industry has its capacity pretty well sold up to the middle of the year, which is significant as to the outlook in the various lines of construction. The railroads are taking a great deal of steel, likewise the builders and automobile and implement manufacturers. House-building is headed toward another big year and office building construction now promises to go ahead of last year. Road-building will continue on about the same or larger scale, and manufacturers of cement, plaster, lumber and all building materials, furniture and furnishings are looking for a record year.

RAILROAD WAGE SITUATION IMPROVED

"Railroad traffic is heavy and the roads are expecting to have the best year yet experienced since they were taken back from government operation. The companies are cultivating friendly relations with their men, and endeavoring to adjust wages satisfactorily by direct negotiations.

"The textile industries are active under the pressure created by an upward tendency of prices. This upward tendency thus far is wholly the result of advances in raw materials. Wool is in strong position all over the world, on account of diminishing stocks, and this is particularly so of the high grades. In all countries the labor cost of making clothes has increased so much that the cost of the raw wool in a suit is a comparatively small item, and the tendency is to expend the labor cost on the best materials. This is especially so in the United States, where the new tariff is favorable to the high grades. The final ginning reports indicate that the cotton crop has fallen short of 10,000,000 bales, which emphasizes the fact already recognized that a critical situation exists in the cotton industry.

"The opening of woolens in the past month for orders for next Fall delivery has established prices ranging from 12½ to 16 per cent over those for last season, and these are accepted by the trade as justified by the higher costs.

"The prices of grains have been unfavorably affected by the strained situation in Europe. The position of the farmers is to some extent prejudiced by the advances that have occurred in the things they must buy, while with the exception of cotton, late movements in farm products have been reactionary rather than upward.

"The banking situation is very comfortable, with an abundant supply of credit for all good borrowers. Rates, however, have undergone little change of late, as the outlook for demand is considered good. Business men as a rule, while exhibiting confidence, are following conservative policies and showing little inclination to become extended, which is the part of wisdom in present conditions.

THE COAL SITUATION

"The bituminous coal operators and miners of the central competitive field, which virtually means all the unionized territory, have come to the agreement to have no strike this year. This understanding was reached by the action of the operators in deciding to make no effort to reduce the present wage-rates —in other words by their conceding without a contest the issue over which the strike was called last year. Doubtless that was the easy way of dealing with the problem so far as the operators were concerned, and there remains only for the consumers of coal to pay the price.

"Wages are now fixed on a basis which is justified upon the theory that the miners will have work approximately only two-thirds of the time. In other words, there are too many miners for the amount of coal to be mined, and inasmuch as it has been considered an undue hardship to require some of them to find other work, public sentiment has supported the doctrine that the price of coal should carry the burden of idle time."

Steel Ingot Output and Unfilled Tonnage Increase

A total of 3,251,694 tons of steel ingots were produced during January, by the thirty companies which turned out 87½ per cent of the country's steel ingot output in 1921, according to reports received by the American Iron and Steel Institute. This represents an increase of nearly 17 per cent over December and more than doubles the output for January, 1922.

The increasing business of the United States Steel Corporation is indicated by the heaviest unfilled steel tonnage in the last twenty-three months, that of 6,910,776 tons on the books Jan. 31, 1923. This shows a gain of slightly over 2 per cent as compared with the preceding month.

Steel ingot production and unfilled tonnage for the month of January, during the last three years, is shown in the following table:

January 31	Tons of Steel Ingots Produced	Unfilled Tonnage on Books
1923	3,251,694	6,910,776
1922	1,593,482	4,241,678
1921	2,203,186	(Feb. 28) 6,933,867

The daily pig-iron output during January averaged 104,181 tons, an increase of nearly 80 per cent as compared with August, 1922. The January figures compare very favorably with those of October, 1920.

Are You Making the Best Use of This Section?

The Business Side of Construction has a definite policy, as those who read it regularly will have learned.

The first issue of each month carries *Engineering News-Record's* Construction Cost and Construction Volume Index Numbers. These show the current cost of general construction and its actual physical volume, compared with conditions in 1913. The money value of contracts awarded in the various classes of construction is also given. The other regular features are "Labor Rates and Conditions Throughout the Country," and the "Monthly Prices of Construction Materials." There are four pages of prices covering the materials of construction.

The second issue of each month features "Production and Materials Stocks in a Dozen Cities." The large, carefully compiled table tells that there are plenty of brick in Atlanta, that the supply of cement in Minneapolis is more than sufficient to meet all normal requirements, that ten cars of asphalt are available in Denver, that mill shipments of structural steel are slow in New York.

The third issue features recent public bond sales, and presents figures of yield, rate, price, and the houses handling the important issues. Some fifty issues are analyzed.

The first issue of every month carries the full list of prices of construction materials and the cost and availability of skilled and unskilled (union and non-union) labor.

All the other issues publish the "Weekly Construction Market," which presents the prices charged for materials and the rates paid common labor in eight of the leading centers of the United States, and the same for Montreal. "Changes Since Last Week" interprets the data.

Construction News requires few words. It has been running for many years. From it engineers, materials men, architects, and other men interested in construction activities obtain work every week. It is a Sargasso Sea of data, requiring only study and segregation. Practically every state in the Union is represented in its superficially dull looking columns each week. Successful construction men study this section each week.

Decision in Metal Trim Case Expected When Board Meets

Washington Correspondence

A decision in the metal trim case which has been a disturbing factor among the buildings trades for two years is expected to be handed down by the National Board for Jurisdictional Awards in the building industry which has been called to meet in Washington Feb. 19. The case was considered two weeks ago at a meeting in Chicago.

It is the metal trim case, or the refusal of the carpenters' union to abide

(Concluded on p. 330)

Value of January Bond Sales Higher Than December

Long-term State and municipal bond sales during January amounted to not less than $93,000,000, according to the *Commercial and Financial Chronicle*. Although the actual number of issues during January was somewhat below the December average, the money value of January bonds was over $32,000,000 greater than the preceding month. This is due to heavy financing by several States and municipalities. January disposals were about $14,000,000 under the $108,000,000 mark reached during the corresponding month last year, when, with municipalities borrowing freely, the number of issues was twice as large.

Temporary loans totaled over $67,000,000 for January, of which $43,325,000 were issued by New York City alone.

Canadian disposals amounted to more than $25,000,000, including $10,053,000 by Toronto; $4,800,000 by Alberta; $2,000,000 by British Columbia and $2,000,00 by Greater Winnipeg Water District.

Among the more important issues of the month were: Detroit, Mich., $20,163,000 4½s and 4¼s, at 100.307, a basis of about 4.37 per cent; North Carolina, $10,073,000, 4½s at a $1,000 premium, or a basis slightly under 4½ per cent; California, $5,000,000 4½s at 100.324, a basis of about 4.23 per cent; Oregon, $5,000,000 4s and 4½s at 100.029, a basis of about 4.40 per cent; Rochester, N. Y., $4,805,000 4s at 100.77, a basis of about 3.93 per cent; Los Angeles, Calif., $4,500,000 4¾s at 103.11, a basis of about 4.51 per cent; Chicago, Ill., $3,000,000 4s at 98.0792, a basis of about 4.22 per cent; Ft. Worth, Tex., $2,750,000 5s at 105.74; and Chicago, Ill., $2,500,000 4s at 98.17, a basis of about 4.22 per cent.

Of the thirty-four representative issues listed in the accompanying table, three sold at par, thirty above and only one below par; the yields ranging from 3.12 to 5.75 per cent.

Rates varied from 4¼ to 6 per cent. The single 4¼ issue was located in Pennsylvania. All the 6's were sold in Alabama, New York and Ontario. The 4½'s were disposed of in Indiana, Massachusetts and North Carolina, while the 5½'s were all in North Dakota, North Carolina and Ohio. Securities drawing between 4¾ and 5¼ per cent were distributed geographically as follows: Southern states, 7; Middle Western, 4; West of Mississippi, 2; Middle Atlantic, 2, and Far Western, 1, the single 5¼ issue being in Iowa.

Federal Reserve Review of Business Conditions

Production and prices remained relatively constant in December, while trade and credit showed the usual increases in the holiday season, followed by declines in January, according to the Federal Reserve Bulletin of February. During January a number of basic materials advanced in price, while cotton, rubber and lead reached the highest points since 1920. Some of the various industries are reviewed as follows:

Construction was somewhat curtailed in the northern districts during December and January, as a result of severe snow storms. Operations have increased in many sections of the South.

The average level of building material prices was unchanged in December. Prices of building materials, however, are now 85 per cent above the average for 1913, whereas the index for all groups published by the Bureau of Labor Statistics has only increased 56 per cent. Shipments of cement showed a marked reduction in December, but were slightly larger than in December, 1921. Production of cement and of various kinds of brick was moderately curtailed, as is customary in the early winter.

Lumber movement during December and early January was featured by an excess of orders booked and shipments over the amount cut. Production, although large for this time of the year, was necessarily curtailed because of winter weather, and shipments which usually exceed the cut at this season were particularly heavy because improved transportation facilities enabled many delayed shipments to be forwarded. Furthermore, dealers are preparing for spring demands by building up stocks and by placing orders for future delivery.

Iron and Steel—Demand for iron and steel products continues to be very strong, and factory operations are on as large a scale as the labor supply permits. Pig-iron production amounted to 3,087,000 tons in December, an increase of 8.3 per cent, while steel-ingot output declined 3.8 per cent to a total of 2,780,000 tons. Prices renewed their upward movement in January, after declining for 3 months. Advances were registered both in pig-iron and finished steel prices. Unfilled orders of the United States Steel Corporation decreased 1.4 per cent during December and totaled 6,746,000 tons at the end

REPRESENTATIVE PUBLIC BOND SALES DURING JANUARY, 1923

State	Purpose	Amount	Rate Per Cent	Sold For	Basis	Maturity	Dated	Purchased By
North Dakota	Real estate developments	$1,650,000	5½	.....	4.50	1945-48	Nov. 1, 1922	C. W. Whitis & Co., and Clark Williams & Co., both of New York
County								
Arlington, Va	School	275,000	4½	100.92	.....	1953	Jan. 26, 1923	Bumpus, Hull & Co. of Detroit
Audubon, Ia	Drainage	19,800	5½	101.28	.....	1927-33	Feb. 1, 1923	Geo. M. Bechtel & Co., Davenport
Du Bois, Ind	Road improvement	15,000	4½	100	.....	1924-33	Feb. 1, 1923	Huntingburg Bank
Floyd, Ind	Road	22,360	4½	101.005	4.64	1924-43	Nov. 15,1922	Peoples' State Bank of Detroit
Franklin, O	Sewer	8,600	5	100.807	4.84	1924-32	Dec. 1, 1922	Provident Savings Bank & Trust Co. of Cincinnati
	Water mains	7,500				1924-31		
Gibson, Ind	Road	7,600	5	101.31	4.745	1924-33	Jan. 15,1923	Farmers' National Bank of Princeton
Paulding, O	Road improvement	67,600	5	101.258	4.71	1925-31	Feb. 1, 1923	Provident Savings Bank & Trust Co. of Cincinnati
Perry, Ind	Road	35,000	5	101.50	4.69	1924-33	Jan. 15,1923	City Trust Co. of Indianapolis
Summit, O	Sanitary improvement	26,000	5	101.57	4.75	1924-36	Jan. 1, 1923	W. L. Slayton & Co. of Toledo
Warren Water Dist., Mass	Water	175,000	4½	103.20	4.22	1926-53	Feb. 1, 1923	R. L. Day & Co. of Boston
Wood, Ohio	Road bridge	37,000	5	100.17	4.97	1924-28	Mar. 1, 1923	Provident Savings Bank & Trust Co. of Cincinnati
Township								
Columbus City School Dist., Franklin Co., O.	School building	400,000	5	105.7836	4.44	1925-48	Feb. 1, 1923	Barr Bros. & Co., Inc., of New York
Sioux Falls Independent School Dist., Minnehaha Co., S. D.	School building	300,000	5	106.36	.....	1943	.....	A. C. Allyn & Co., of Chicago
Municipality								
Almont, Mich	Sewer	$25,000	5	100.3464	4.91	1925-29	Feb. 1, 1923	Joel L. Stockard & Co.
Anniston, Ala	Sewer	56,000	6	102.50	.....	1932	Oct. 1, 1922	Ward, Sterne & Co., Birmingham
Asheboro, N. C	Sewer	7,500	5	100	.....	1923-52	Dec. 1, 1922	W. J. Armfield and J. S. Lewis, Asheboro
Athens, Ala	School	20,000	5	91	5.62	1953	Jan. 1, 1923	Caldwell & Co. of Nashville
Atlanta, Ga	Streets	75,000	5	102.79	.....	1925-32	Jan. 1, 1923	Citizens' & Southern Co. of Atlanta
Bradley Beach, N. J	Improvement	55,000	5	100.50	4.94	1925-42	Feb. 1, 1923	Union National Corp. of New York
Charlotte, N. C	Street Improvement	700,000	4½	100.41	4.72	1925-43	Feb. 1, 1923	Geo. B. Gibbons & Co., Inc., of New York
	Sewerage	100,000	4½	100.03	4.49	1926-63		
Crown Point, Ind	Waterworks	15,000	5	103.78	.....	1933	Aug. 21,1922	Harris Trust and Savings Bank of Chicago
Dresden, N. Y	Bridge	7,500	6	101.50	5.75	1924-38	Feb. 15,1923	Merchants National Bank of Whitehall
Fort Edward, N. Y	Paving	8,000	5	100	.....	1924-27	Jan. 1, 1923	Fort Edward National Bank
Hamilton, O	Electric light works improvement	650,000	5	.....	4.50@4.40	1925-44	Apr. 1, 1920	Stacey & Braun and Sidney Spitzer & Co.
Harrisonville, Mo	Sewer	60,000	5	100.17	4.98	1928-43	Feb. 1, 1923	Brown-Crummer Co. of Wichita
Los Angeles, Calif	City improvement	96,000	5	101.67	.....	.....	.....	The First Securities Co. of Los Angeles
Ludlow, Ky	Fire Dept. and City building	40,000	5	101.01	4.80	1924-33	Feb. 1, 1923	Ludlow Savings Bank
Middleburg, N. Y	Bridge	12,000	5	102.19	4.60	1924-35	Feb. 1, 1923	First National Bank
Nacogdoches, Tex	Street improvement	225,000	5	100.44	.....	1923-63	Jan. 30, 1923	Stone Fort National Bank and Commercial Guaranty State Bank
Reading, Pa	School	300,000	4½	102.67	3.12	1924-40	Jan. 1, 1923	Reading National Bank
Statesville, N. C	Local improvement	50,000	5½	103.267	5.11	1926-43	Jan. 1, 1923	N. S. Hill & Co. of Cincinnati
	Assessment	25,000	5½	103.267	5.11	1926-35		
Upper Arlington, O	Sewer	92,000	5½	100.48	5.385	1923-32	Oct. 2, 1922	Citizens' Trust & Savings Bank of Columbus
Grimsby, Ont	Water works	30,000	6	101	.....	.....	Jan. 25,1923	C. H. Burgess & Co. of Toronto

of the year. Particularly large orders have been placed by farm-implement manufacturers, railroads, and automobile factories since the beginning of 1923, and wire mills have been obliged to allocate their output for the first quarter of the year.

Automobiles—Production of automobiles was only slightly curtailed in December and was almost three times as large as a year ago. Passenger-car output totaled 207,501, as compared with 215,225 in November and 70,435 in December, 1921; while the number of trucks produced was 19,640, as compared with 21,291 in November and 8,183 in December, 1921.

Decision in Metal Trim Case

(*Concluded from p. 328*)

by the previous decision in this case, which has threatened the existence of the Board. While this body is purely unofficial, it has accomplished so much toward bringing order out of the previous confusion among trades unions that official Washington has come to depend heavily upon its functions.

The carpenters' union has insisted that it was not given full opportunity to present its case at the first hearing, which preceded a ruling that metal trim work belonged to the jurisdiction of the metal workers' union.

Bids wanted on grain elevator, Montreal, Que., for J. S. Metcalfe Co., Ltd., $10,000,000; warehouse, Cincinnati, O., for Cincinnati Terminal Warehouse Co., $2,000,000.

Large contracts let during week: Hotel, Minneapolis, Minn., to C. F. Haglin & Sons Co., $3,000,000; Y. M. C. A. building, New York, N. Y., to G. A. Fuller Co., $1,200,000.

Next week—Trend of lumber production and shipments during last thirteen months.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted. Valuable suggestions on costs of work can be had by noting actual biddings as reported in our Construction News section. The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of February 1; the next, on March 1.

Steel Products:	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Structural shapes, 100 lb.	$3.29	$3.95	$4.40	$3.05	$3.30	$3.95	+$3.35	$3.80	+$3.75
Structural rivets, 100 lb.	3.85	4.60	5.25	3.75	4.00	4.95	4.75	4.25	5.50
Reinforcing bars, ¾ in. up, 100 lb.	3.19	3.85	3.15	2.95	3.20	3.62½	3.30	3.80	3.25
Steel pipe, black, 2½ to 6 in. lap, discount	51%	53%	45%	59½%	55-5%	38%	+38.2@46.5%	45%	+32.76
Cast-iron pipe, 6 in. and over, ton	56.00	50.00	56.00	+54.20	+58.50	65.00	+57.00	+57.00	55.00
Concreting Material:									
Cement without bags, bbl	2.60@2.70	2.75	2.25	+2.20	+2.39	2.85	2.71	2.90	+2.88
Gravel, ¾ in., cu.yd.	2.00	1.75	2.25	2.25	1.75	1.90	2.15	1.00	1.50
Sand, cu.yd.	1.00	1.24	1.87½	2.25	1.00	1.00	1.50	1.00	1.25
Crushed stone, ¾ in., cu.yd.	1.75	2.00	2.00	2.25	2.25	3.50	2.15	3.00	1.90
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft.	61.00	+37.00	50.00	56.50	42.75	54.00	36.00	29.00	+95.00
Lime, finishing, hydrated, ton	16.80@17.10	23.00	22.50	18.00	25.50	24.00	22.00	24.00	21.00
Lime common, lump, per bbl.	3.00@3.25	1.85	2.50	1.40	—1.25	2.70	1.75	2.80	11.00
Common brick, delivered, 1,000	23.50	+12.00	11.00	11.00	17@19	12.00	15.50	13.00	16.00
Hollow building tile, 4x12x12, per block	Not used	.0859	.115	....	.0836	.065	....	.11	+.115
Hollow partition tile 4x12x12, per block	.1230	.0859	.115	.0674	....	.065	.108	.11	....
Linseed oil, raw, 5 bbl. lots, gal.	+.99	1.03	1.07	1.02	+1.07	+1.19	1.04	.86	1.02
Common Labor:									
Common labor, union, hour	.60	.35	.30@.50	.....	.....	.50@.55	.56¼	.50@.60	.....
Common labor, non-union, hour	.45@.60	.30	.30@.50	.72½	.35@.50	.35@.50	.50	....	—.25

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. Increases or decreases from previous quotations are indicated by + or — signs. For steel pipe, the prevailing discount from list price is given: 45-5% means a discount of 45 and 5 per cent. Charge is 15c. per 100 lb. for cutting reinforced steel into 2-ft. lengths or over.

New York quotations delivered, except sand, gravel and crushed stone, alongside dock; common lump lime, in 280-lb. bbl. net, and hydrated lime f.o.b. cars; tile "on trucks"; linseed oil and cast-iron pipe f.o.b. Cement and concrete laborers' rate, 81½c.; pick and shovel men, 60c. per hr.

Chicago quotes hydrated lime in 50-lb. bags; common lump lime per 180-lb. net. Lumber delivered on job.

Minneapolis quotes on fir instead of pine. Brick, sand and hollow tile delivered. Cement on cars. Gravel and crushed stone quoted at pit. We quote on brown lime per 180-lb. net; white is $1.55 for Kelly Island and $1.45 for Sheboygan. Common labor not organized.

Denver quotes on fir instead of pine. Cement "on tracks"; gravel and sand at pit; stone on cars; lime, brick, hollow tile and lumber on job. Tile price is at warehouse. Linseed oil, delivered, in wooden bbl. Common lump lime per 180-lb. net.

Atlanta quotes sand, stone and gravel per ton instead of cu.yd. Common lump lime per 180-lb. net.

Dallas quotes lime per 180-lb. bbl. Steel, cement, cast-iron pipe and crushed stone f.o.b. cars, other materials delivered.

San Francisco quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses except C. I. pipe, which is mill price plus freight to railway depot at any terminal. Common lump lime per 180-lb. net. Lumber prices are to dealers in yards at San Francisco, for No. 1 fir common.

Seattle quotes on Douglas fir (delivered) instead of pine. Lump finishing lime per 180-lb. net. Hollow building tile delivered. Hydrated lime in paper sacks. Sand and gravel at bunkers.

Montreal quotes on pine casing. Sand, stone, gravel and lump lime per ton. Cement, lime and tile are delivered; sand, gravel and stone on siding; brick f.o.b. plant; steel and pipe at warehouse. Hollow tile per ft. Cement price is in Canadian funds (the Canadian dollar stands at 98.91). Bag charge is 80c. per bbl. Discount of 10c. per bbl. for payment within 20 days from date of shipment. Steel pipe per 100 ft. net; 2½-in., $32.76; 6-in., $108.

Changes Since Last Week

Following the recent advances in coke and pig iron, steel shapes and reinforcing bars rose to a minimum of $2.25 per 100 lb., Pittsburgh, in small lots for early delivery; plates $2.35. This advance is equivalent to $2 per ton over last week's maximum of $2.10 per 100 lb. at the mill.

The present price level is up to the emergency quotations of the early part of September, at which time a 20 per cent wage increase and heigher fuel costs caused an advance. An unusual demand for oil-country goods, fabricated structural steel and automobile and agricultural implement materials, is responsible for the present rise. Shapes and bars, however, quoted at a minimum of $2.15 and plates at $2.20, on exceptionally large contracts.

Wrought steel pipe advanced in San Francisco and Montreal during week. Cast-iron pipe rose $1 in San Francisco and Seattle and $2 per ton in Minneapolis and Chicago.

A firmer cement market is reflected in the following changes: advances of 10c. per bbl. in Cleveland, Duluth, Minneapolis, Pittsburgh and St. Paul; 14c., in Detroit and 15c., in Cedar Rapids, Chicago, Cincinnati, Davenport, Indianapolis, Milwaukee, Peoria and Toledo.

Lumber prices also show considerable firmness due to heavy demand for railroad car materials and bridge timbers, to orders from retail yards to replenish depleted stocks and to continuance of construction activity.

Linseed oil rose 3c. in New York and Minneapolis and 6c. per gal. in Denver, during week. General tendency of lead and linseed market higher.